SERVICE MANUAL



HAMMOND X-5 COMBO ORGAN

The Hammond X-5 is the first truly portable organ that embodies all the traditional capabilities of Hammond tonebar organs. It's a synthesis organ that allows you to create your own sound. It's easy to set-up, compact, and weighs only 165 lbs.

- Two 44-note keyboards with overhang keys.
- 13-note pedalboard.
- Nine harmonic tonebars for upper keyboard.
- Seven harmonic tonebars for lower keyboard.
- One 16' harmonic tonebar for bass.
- Vibrato: 3 degrees and off.
- Reverberation: 3 degrees and off.
- 4 presets plus upper and lower tonebar positions.
- Synthesis touch-response percussion.
- Fast and Slow Decay.
- Variable speed repeat/reiteration on percussive voices.
- Acoustic tremolo speaker outlet (Leslie® 910), plus two-speed on/off control tabs.
- 16' and 8' pedal tab.
- Two String Bass tabs: 3 decay times, plus Mute tab.
- Brilliance Knob, continually variable.
- Volume control knob.
- Input jack for external instruments.
- Line-out jack for other amplifiers.
- External speaker jack.

SPECIFICATIONS: Weight: 165 lbs. • Power Source: 60 cycle AC 120 V. • Dimensions: 44½" W., 36" H., 25" D. • Accessories: Legs.

PRODUCT SERVICE

For product service, contact nearest authorized Hammond Service Center or write to: Manager, Product Service, Hammond Organ Company, 4200 West Diversey Avenue, Chicago, Illinois 60639.

Parts are also Available by Contacting Product Service as Mentioned Above.

IMPORTANT:

Always supply model designation and serial number when writing.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

SECTION IV – ILLUSTRATION PARTS LIST

SECTION I.
HOW THE ORGAN OPERATES

X-5 – 18050K
GENERAL PERFORMANCE DESCRIPTION

1-1 GENERAL
This section contain a brief description of the various sections of the instrument.

1-2 CABINETRY
The metal frame and wood panels-coated with vinyl leather and CHS- form the case work. Case has a metal handle for carring and a removable key cover.

1-3 TONE SOURCE
The X-5 (18050K) utilizes the single master oscillator with the multiderivative divider (MDD) system. The twelve (12) I.C.'s mounted on the 229-20316 (DV-4B) Divider Generator Board provide the division of outputs and provide the sine wave tones -seventy nine (79) tones- made use of by the instrument.

1-4 MANUAL
The 18050K uses two (2) 44 note Manual that Upper Manual has 10 contacts under each key. The Manuals provide means of switching signals from 229-20316 Generator Board and keying voltage to the 219-04312 Gate & Percussion Board. The lowest one of these contacts is used for switching voltage for Gate & Percussion, and Others are used for switching the signal directly.

1-5 TONE BARS
Three Groups of Tone Bars complement the Upper Manual, Pedal and Lower Manual. They carry the footage markings and vary loudness.

1-6 PRESETS OR TAB VOICING
The three (3) Presets Tabs may bring in pre-set tones instead of the setting of the upper Tone Bars, And the One (1) Preset Tab may bring in those of lower Tone Bars. They may be used individually. The presets have the following Tone Bar structure.

	Lower Tone Bars
Preset Ensemble	068666 444
	Upper Tone Bars
String	008888 666
Full Tibias	806808 006
Theater Brass	848868 666

Depression of either Preset Tab disconnects the setting of the Tone Bars, and all Tabs turn to "Off" position and restore the Tone Bars. On Upper Presets, the right-hand Tab has priority over the left-hand Tabs. The Tabs used are of the current switch type. The Preset Tabs are located on the lower left-hand End Block Assembly. The End Block also contains other Tabs whose functions are the following: Percussion (Second Harmonic, Third Harmonic, Decay, Repeat), Vibrato and Leslie (Acoustic-Tremolo).

1-7 PERCUSSION
Percussion Tones are switched on by the Tabs, which are Second Harmonic and Third Harmonic. Each footage of the pitch corresponds to 4' and 2-2/3' of Tone Bars. Percussion affects all upper Tone Bar setting, but not Preset Tones. It has two decay times, approximately 1.5 seconds (Slow) and 80 msec. (Fast).

1-8 REPEAT
The same Percussion gate can be activated by a reiteration or repeat Oscillator, and affect the same Percussions. The Oscillator rate is variable from 13 times/10 seconds to 500 msec. The Repeat Rate control is located on the lower right-hand End Block Assembly. The End Block also contains other Tabs and controls whose functions are the following: Pedal, String Bass, Mute, Reverb, Volume, and Brilliance.

1-9 PEDALS

A 13 note Spinet Pedal of the Block Module Design is used. The keying contacts are used the Rocker type, with the middle contact used for Common. A series of latching D.C. gates determines the desired bass note. These contacts are wired High-Note Select. The latching Keyer Gates hold for at least two (2) seconds, but release instantly with the next pedal depressed. The selected output is then amplified to produce the 8' bass note and then frequency-divided one (1) time in F-F circuit to produce the 16' bass note. An output gate controls the Pedal Sustain envelope. The sustain decay time is selected by String Bass Tabs, those its decay times are follows:

Tab	Decay Time
String Bass I	350 msec.
String Bass II	700 msec.
String Bass III (I + II)	1.5 sec.

The Bass Note is selected 8' and 16' by Pedal Tab. The Mute Tab affects all Bass Tones.

1-10 VIBRATO

A Master Oscillator Vibrato offers three (3) widths at one speed that affects all voices. This rate is 6.6 ± 0.2 Hertz. Vibrato II is wider than I, and the two Tabs are additive, so the Vibrato is widest when both on.

1-11 VOLUME

This Knob controls the overall volume of the organ soft to loud, and its variable range is about 30 dB.

1-12 BRILLIANCE

This Knob controls the overall tone of the organ soft to bright, then gradually attains a slope of 6 dB/octave and alters the response about 16 dB at 3000 Hz.

1-13 EXPRESSION PEDAL

The assembly is made of steel frame, utilizing a single channel.
The variable range is about 22 dB at minimum position.

1-14 REVERBERATION

Three (3) degrees of Reverb. are available, which affects all organ tones.

1-15 EXT. INPUT

An input suitable for other Signal-generating devices is provided and located under the right-hand Lower End Block of the cabinet.

1-16 REMOTE TONE CABINET

A jack is provided suitable for an 8 ohm Speaker.
A socket is provided suitable for a Leslie 910 Tone Cabinet. The signals are taken from the organ output following the Leslie Selector Tabs, and On/Off, Fast/Slow control Tabs are coupled through the Standard Cable to the Tone Cabinet. Jack and socket are located on amplifier in the Pedal Cabinet.

1-17 AMPLIFIER

A single channel 30 Watt Block Module Design is provided and located in the Pedal Unit Assembly.

SECTION II. DISASSEMBLY

2-1 GENERAL

This section contains instructions for removal of specific assemblies of the organ. Step 2-2 thru 2-13 provide disassembly procedures for the Upper Section (Manual Keyboard) of the organ. Steps 2-14 thru 2-17 provide disassembly procedures for the Lower Section of the organ. The removal of some sub-assemblies and unplugging connectors or unsoldering is obvious. These will not be discussed.

For reassembly, use reverse procedures.

UPPER SECTION

2-2 TOP PANEL

a) Two (2) bronze screws (6½" long) located under Upper Section must be removed FIRST. (Note – See Figure 2-1 for location).

b) Near top and center of each side of Upper Section remove bronze screw.

c) From front of top panel, lifting evenly, raise top to swing up position.

2-3 UPPER MANUAL ASSEMBLY

a) See figure 2-1 for location – Remove six (6) 1" long bronze screws from under side of Upper Section.

b) Raise manual to swing up position. (Do not lift by keys).

2-4 END BLOCKS – LOWER MANUAL

a) Remove two (2) phillips screws from rear of each End Block Assembly.

b) Carefully lift up and avoid marring or scratching.

2-5 LOWER MANUAL ASSEMBLY

a) Lower Manual End Blocks should be removed first to avoid damage to case or other assemblies.

b) See Figure 2-1 for location. Remove four (4) 1" long bronze screws from under side and toward front of Upper Section.

c) Carefully, Manual can be placed in up right position. (Do not lift by keys).

2-6 TONE BAR ASSEMBLY

a) Unplug Upper and Lower tone bar connectors for T.G-15 (B) PWB assembly located under Upper Manual Assembly.

b) Remove self tapping screws mounting Tone Bars to Upper Manual Assembly.

2-7 POWER SWITCH AND UPPER MANUAL RIGHT HAND END BLOCK.

a) Follow steps 2-2 thru 2-3.

b) Remove End Block, by removing one (1) screw at rear, top of End Block. Screw located under felt.

c) Raise manual and from under End Block remove screw.

d) Between Front Strip, remove small screw fastening strip to End Block. Lift up End Block.

e) From under side of End Block, remove two (s) screws fastening cover to switch. Remove cover.

f) To remove power switch – after End Block is loose from Manual, remove two (2) black screws from top of End Block. Switch now can be removed from under side of End Block. Reassemble in reverse procedure.

2-8 TO REMOVE END BLOCK POTENTIOMETERS

a) Follow step 2-2 thru 2-5.

b) Remove knob of potentiometer. (Volume, Brilliance, or Repeat), by loosening small set screw in knob.

c) Remove End Block by removing two (2) screws top rear of End Block. Lift Block.

d) Remove hex nut securing potentiometer to End Block, Potentiometer can be removed from bottom side of Assembly.

2-9 ROCKER TABS (REMOVAL)

a) Proceed as stated in Stepes 2-2 thru 2-4.

b) From under side of End Block, remove top and bottom screw of associated Rocker Tab Assembly. Rocker Tab will lift out.

DISASSEMBLY CONTINUED

2-10 PRINTED WIRING BOARDS (REMOVAL)

a) The removal of PWB Assemblies is quite obvious and will not be necessary to describe.

2-11 TO REPLACE UPPER OR LOWER MANUAL KEYS.

a) Follow Steps 2-2 thru 2-3. Upper Manual and thru 2-5 Lower Manual.

b) Remove several locking "S" Springs holding plastic covered rod in area of key or keys to be replaced.

c) Remove key spring from rear of key channel.

d) Lift rear of key channel slightly and in a forward motion carefully remove key and channel assembly from manual. In the removal of sharp (black) keys, it will be necessary to remove neighboring keys. Reassemble in reverse procedure.

c) NOTE – Key contact adjustment can be made by turning most forward screw on key and channel assembly (in or out) for key depth.

2-12 POWER SUPPLY

a) Follow steps 2-2 thru 2-3.

b) Remove six (6) screws fastening cover above power supply assembly – Remove cover.

c) From under side, right rear of Upper Section remove four (4) screws. See Figure 2-1 for location.

d) Carefully unplug and lift assembly out.

2-13 ACCESS TO REVERB UNIT

a) Follow Steps 2-2 thru 2-3.

b) Remove six (6) screws fastening cover above power supply. Remove cover.

c) Remove two (2) screws and fasteners hold EF-12 PWB.

d) Remove four (4) screws fastening MG-4 PWB to hinged panel. Carefully unplug and remove.

e) Remove four (4) nuts and washers from rear of swing panel.

f) Carefully raise panel and gain access to reverb assembly.

LOWER SECTION

2-14 EXPRESSION PEDAL ASSEMBLY

a) Remove four (4) nuts fastening base of Assembly to Lower Section.

b) Lift out.

c) To remove pedal from the metal base. Rubber mat of pedal can be removed by lifting edges of mat. Mat will lift and peel off.

d) With mat removed, remove four (4) screws holding metal pedal to Base Section and separate. Reassembly in reverse procedure.

2-15 TO REMOVE LOWER SECTION COVER

a) From under side of Lower Section. Remove ten (10) phillips screws.

b) Cover will lift off.

2-16 POWER SUPPLY ASSEMBLY

a) Remove cover as stated in Step 2-15.

b) Remove four (4) nuts fastening amp to wood base.

2-17 PEDAL KEYBOARD ASSEMBLY

a) Remove six (6) nuts and washers mounting keyboard assembly to wood base.

b) Pedal assembly will lift off.

c) Contact switch assemblies can be removed by loosening screws at each end of switch module and slide away from screw and lift up. Reassemble in reverse procedure.

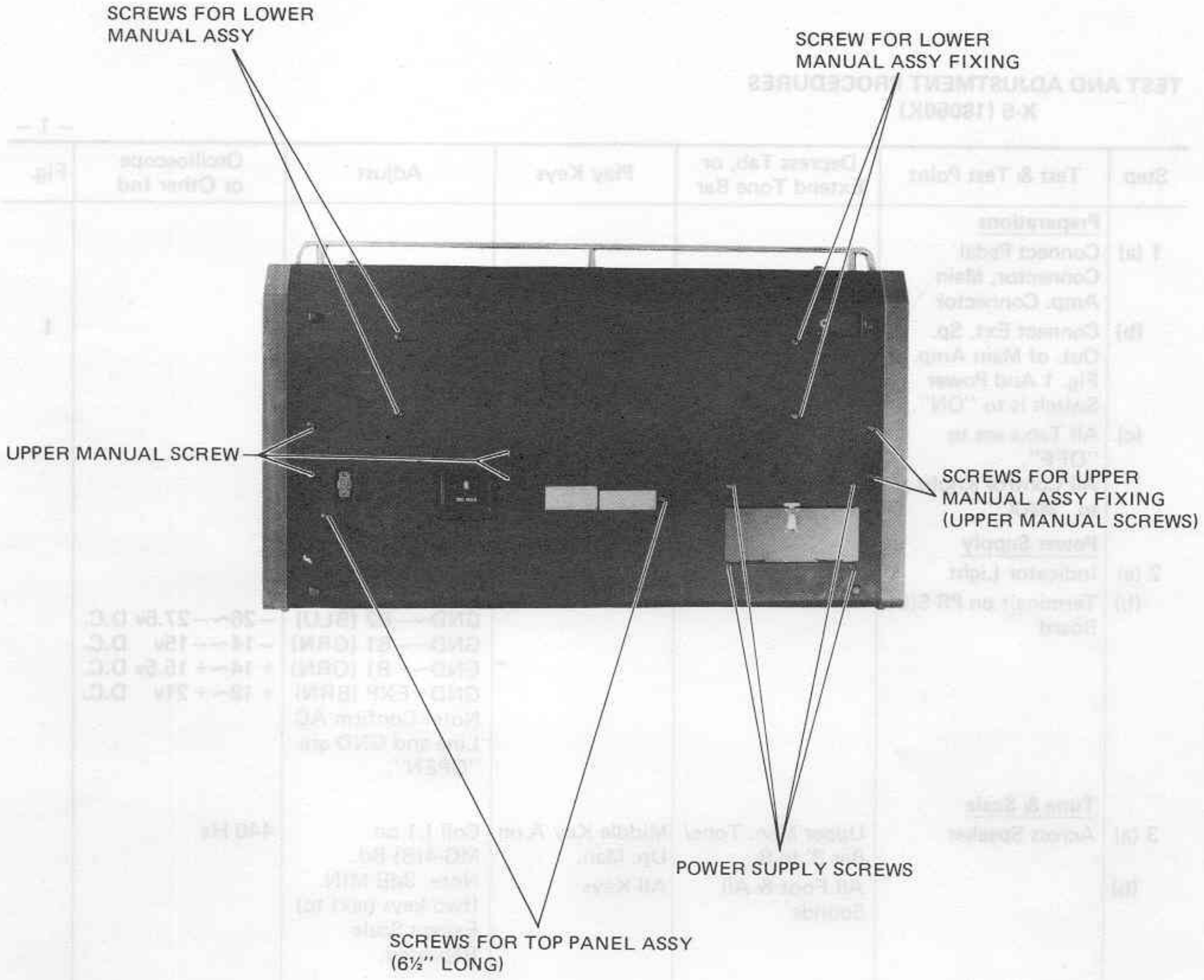

SCREWS FOR LOWER MANUAL ASSY
SCREW FOR LOWER MANUAL ASSY FIXING
UPPER MANUAL SCREW
SCREWS FOR UPPER MANUAL ASSY FIXING (UPPER MANUAL SCREWS)
POWER SUPPLY SCREWS
SCREWS FOR TOP PANEL ASSY (6½" LONG)

FIGURE 2-1

TEST AND ADJUSTMENT PROCEDURES
X-5 (18050K)

Step	Test & Test Point	Depress Tab, or Extend Tone Bar	Play Keys	Adjust	Oscilloscope or Other Ind	Fig.
	Preperations					
1 (a)	Connect Pedal Connector, Main Amp. Connector					
(b)	Connect Ext. Sp. Out. of Main Amp. as Fig. 1 And Power Switch is to "ON".					1
(c)	All Tab.s are to "OFF". All Control Knobs are to "MAX.".					
	Power Supply					
2 (a)	Indicator Light			Note: Confirm Light "ON".		
(b)	Terminals on PS-5(B) Board			GND~–B2 (BLU) GND~–B1 (GRN) GND~+ B1 (ORN) GND~EXP (BRN) Note: Confirm AC Line and GND are "OPEN".	–26~–27.5v D.C. –14~–15v D.C. + 14~+ 15.5v D.C. + 18~+ 21v D.C.	
	Tune & Scale					
3 (a)	Across Speaker	Upper Man. Tone/Bar 8′ to 8	Middle Key A on Up. Man.	Coil L1 on MG-4(B) Bd.	440 Hz	
(b)		All Foot & All Sounds	All Keys	Note: 3dB MIN. (two keys next to) Except Scale Repeated.		
	Output Level					
4 (a)	Across Speaker	Up. Man. 8′ Tone/Bar to 8 Low. Man. 8′ Tone/Bar to 8	Middle Key C on Upper & Lower Man.	Pot. VR1 on PA-33(B) Bd.	Conform Upper Man. & Lower Man. is same level.	
(b)		Ensemble Tab. to "ON".	Mid. C, E, & G on Lower Manual	Pot. VR1 on PA-56 Bd.	3.4v rms.	
		String Tab. to ON Full Tibias Tab. Theater Brass Tab.	Mid. C, E, & G on Upper Manual		4.5v ± 0.5v rms. 4.5v ± 0.5v rms. 4.9v ± 0.5v rms.	
(c)		Upper Man. Tone Bar		Note: All levels are ±20% MAX.		
		16′ Tone/Bar			3.5v rms.	
		5-1/3′ "			2.6v rms.	
		8′ "			2.8v rms.	
		4′ "			2.0v rms.	
		2-2/3′ "			2.0v rms.	
		2′ "			2.3v rms.	
		1-3/5′ "			2.3v rms.	
		1-1/3′ "			2.3v rms.	
		1′ "			2.5v rms.	

Step	Test & Test Point	Depress Tab, or Extend Tone Bar	Play Keys	Adjust	Oscilloscope or Other Ind	Fig.
(c)		Lower Man. Tone Bar				
		8' Tone/Bar			2.9v rms.	
		4' "			2.3v rms.	
		2-2/3' "			2.0v rms.	
		2' "			2.2v rms.	
		1-3/5' "			2.2v rms.	
		1-1/3' "			2.1v rms.	
		1' "			2.4v rms.	
	Pedal					
5 (a)	I Pedal Decay Time Across Speaker	Pedal Tab. 8' & String Bass I & II Tab. to "ON"	Pedal Key C of High Note	Pot. VR2 on SB-5(B) Bd.	1.5 sec.	2
		String Bass Tab. to "OFF".			150 msec. ± 15 msec.	
		String Bass Tab. I to "ON".			400 msec. ± 40 msec.	
		String Bass Tab. II to "ON"			800 msec. ± 80 msec.	
(b)	II Pedal Level Across Speaker	Pedal Tone Bar to 8	Pedal Key C of High Note	Pot. VR1 on SB-5(B)	3.4v rms.	
		Pedal Tab. to 8'	Pedal Key G		4.5v ± 0.5v rms.	
			Pedal Key C of Low Note		5.4v ± 0.5v rms.	
		Pedal Tone Bar to 8 Pedal Tab. to 8' Mute Tab. to "ON"	Pedal Key C of High Note		2.3v ± 0.5v rms.	
	Extent of Expression Pedal					
6 (a)	Across Speaker	Full Tibias Tab. to "ON".	Mid. Key C on Up. Man.	Level is at −20dB ∼ −24dB when Exp. Pedal MAX to MIN. (Level is 0dB at Exp. Pedal MAX)		
	Noise Level					
7 (a)	Across Speaker	All Tab.s to ON (Except Reverb Tab. & Mute Tab.) All Tone Bars to 8			5 mv rms. MAX.	
		All Tab.s to OFF	Mid. Key C on Up. Man. & Low. Man.		10 mv rms. MAX.	
		All Tone Bars to O (OFF), and Percussion Tab.s to ON			No noise occurs.	

*NOTE: During Test Procedure The Following Must Be Maintained Unless Otherwise Stated:

a. All Control Knobs and Expression Pedal at Maximum.

b. All Tab.s and All Tone Bars in the Off Position.

Step	Test & Test Point	Depress Tab, or Extend Tone Bar	Play Keys	Adjust	Oscilloscope or Other Ind.	Fig.
	Brilliance & Freq. Response					
8 (a)	Across Speaker	Upper Man. Tone/ Bar 4′ to 8	Upper Man. Key F of Lowest Note Up. Man. Key F of Highest Note	Point of Brill. Volume Max. MIN. 0dB (Set to Volume Control) –2dB –4dB –13dB –20dB		
	Percussion					
9 (a)	Across Speaker	Second Harmonic Tab. to "ON" Decay Tab. to "Slow"	Middle Key C on Upper Manual	Pot VR2 on PA-33(B) Board	t; 1500 msec.	3
		Next Decay Tab. to "Fast"			t; 90 msec.	
		Third Harmonic Tab. as in step to do Sec. Harm. Tab.	Check as same to Second Harmonic.			
	Repeat					
(b)	Across Speaker	Second Harmonic Tab. to "ON" Decay Tab. to "Slow"	Middle Key C on Upper Manual	Reit Volume to "Slow"	t; 500+100 msec.	4
		Repeat Tab. to "ON", and Decay Tab. to "Fast"		Reit to Slow (MIN.) Reit to Fast (MAX.)	Reit; 13+3 times/ 10 sec. Reit; 70+7 msec.	
	Vibrato					
10 (a)	Test Point R-26 on MG-4(B) Bd.	Vibrato I & II Tab. to "ON"		Pot. VR1 on MG-4(B) Board Pot. VR2 on MG-4(B) Board	t; 152 msec. (6.8Hz) 8v p-p	5 6
		Vibrato I & II Tab. to "OFF"			0v	
		Vibrato I Tab. to "ON"			2v p-p	7
		Vibrato II Tab. to "ON"			4v p-p	
	Reverb					
11 (a)	Test Point R-43 & J4 on PA-56 Board	Low. Man. Tone Bar 8′ to 8	Middle Key C on Lower Manual	Pot. VR2 on PA-56 Board	2v p-p	7
(b)	Test Point Reverb Tab. & Ear	Reverb I & II Tab. to "ON"	Mid. Key C E & G on Low. Man.	Pot. VR4 on PA-56 Board	About 70 mv & Decay Time: 2.5-3 sec.	8
(c)	Balance Ear			Pot. VR3 on PA-56 Board	Same Level on Reverb "OFF" from I & II to "ON"	

Step	Test & Test Point	Depress Tab. or Extend Tone Bar	Play Keys	Adjust	Oscilloscope or Other Ind	Fig.
12 (a)	**Other Operation**					
12 (a)	Leslie Socket; Pin 7, Pon 6, & 1	Leslie ON/OFF to "ON" Leslie Slow/Fast to "Fast" Leslie ON/OFF to "OFF"	Note: That Pin 6 is grounded (to Pin 1) and that Pin 7 is removed from ground (Pin 1). If Tab. is returned to Slow, Pin 7 will be grounded. Pin 6 and Pin 7 are removed from ground (Pin 1).			9
13 (a)	Ear	Ensemble Tab. to "ON" Lower Man. Tone/Bar sets to: 8666444	Note: Same Tone as Tone Bar Setting.			
		String Tab. to "ON" Upper Man. Tone/Bar sets to: 008888666	Same Tone as Tone Bar Setting.			
		Full Tibias Tab. to "ON" – do –, sets 806808006	– ditto –			
		Theater Brass Tab. to "ON" – do –, sets 848868666	– ditto –			

14 Test of Mechanism Operation

- a) Confirm that Tone Bars are easy to operate, and that one Tone Bar doesn't disturb other Tone Bar operation, and that Mark 8 is visible.
- b) Confirm that Keyboards are operational.
- c) Confirm that Expression Pedal is normal to operate and to stop at will.
- d) Confirm that position of Knob Mark is normal.
- e) Confirm that Pedal Keys are normal to operate.
- f) Confirm that Tab.s are normal to operate.

15 Assembly

- a) Confirm that Cabinet can be put on the Leg.
- b) Confirm that Pedal Unit can be smoothly inserted.
- c) Confirm that Knob Bolts can be set normally.

Step	Test & Test Point	Adjust	Oscilloscope or Other Indication	Fig.
	Main Amplifier			
16 (a)	Preparations Across Ext. Sp. Out	Connection as Fig. 10, 11		10
(b)	Test Point R26 on PW-27(B) Board	Pot. VR1 on PW-27(B) Board Note: Set VR1 to turn left, and turn right, Stop at 10mV Point.	Sot 10mV, and about afteral Minute 35mV + 5mV	11
(c)	Across Ext. Sp. Out	Input: 0.3V rms. (1000Hz) . . . . . Output: 16V	Note: Confirm that Output Wave Form is normal or not.	10
(d)	Test Point GND . . . . + Vcc GND . . . . + Vcc		+ 30V ~ + 35V DC –30V ~ –35V DC	

FIGURE

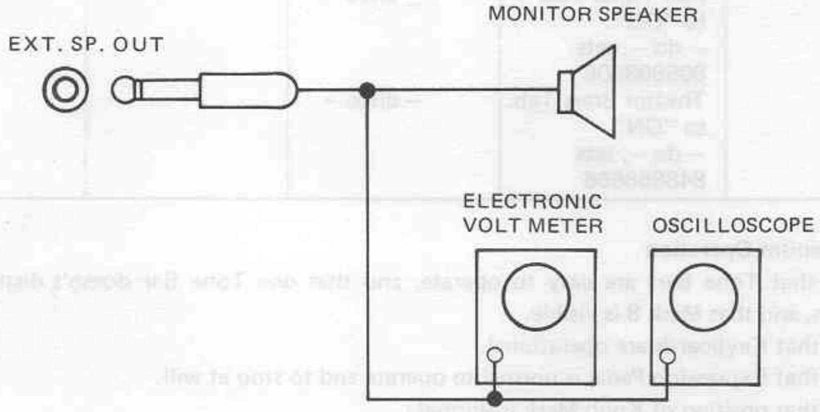


Fig. 1

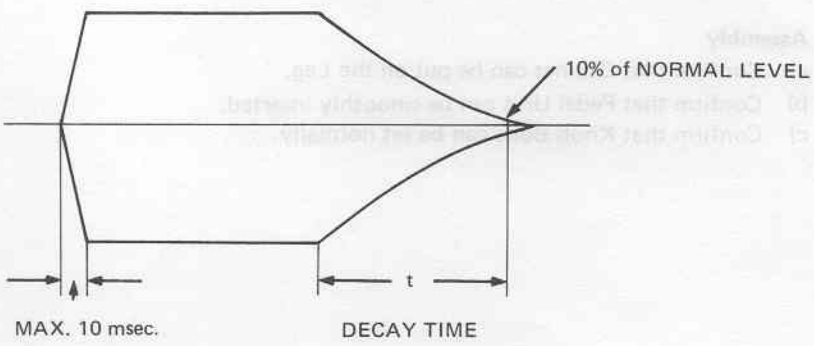


Fig. 2

Fig. 3

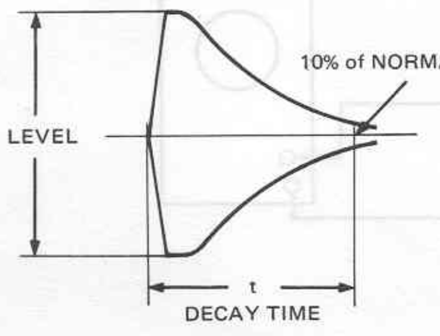


Fig. 4

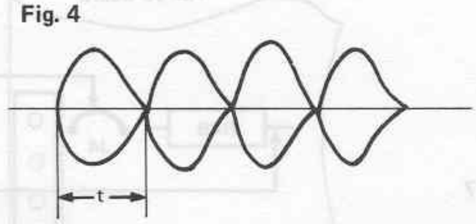


Fig. 5

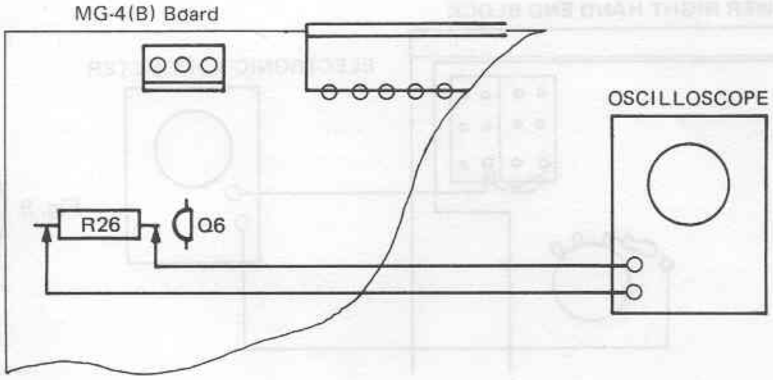


Fig. 6

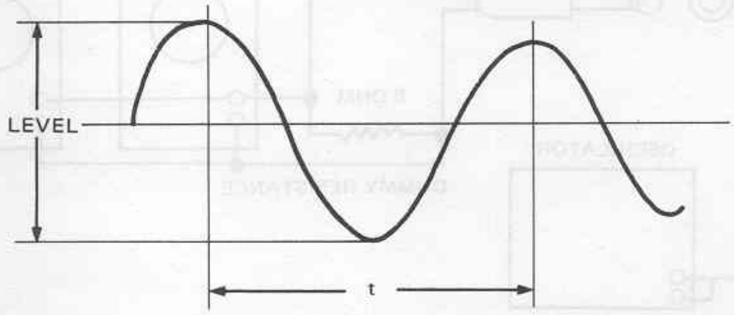


Fig. 7

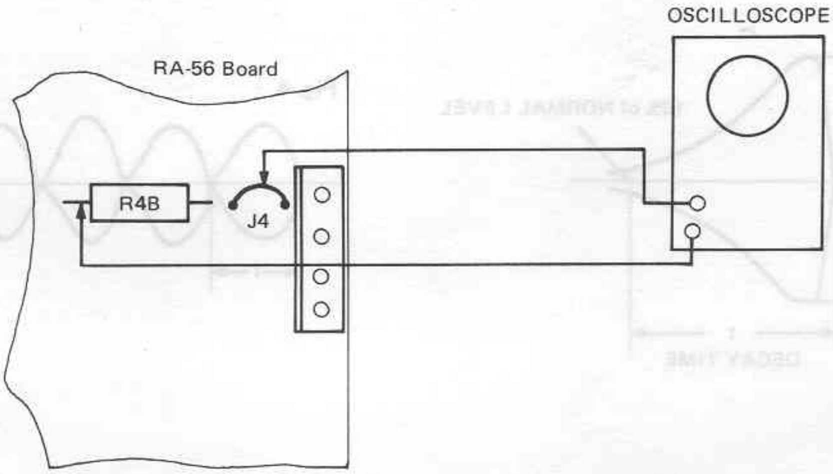


Fig. 8

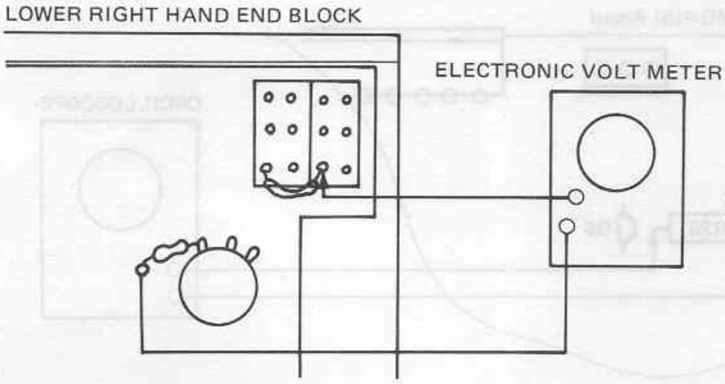


Fig. 9



Fig. 10

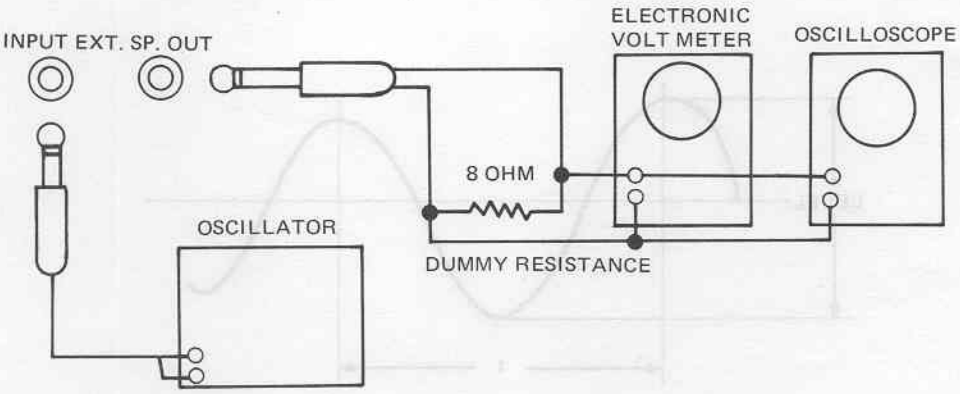
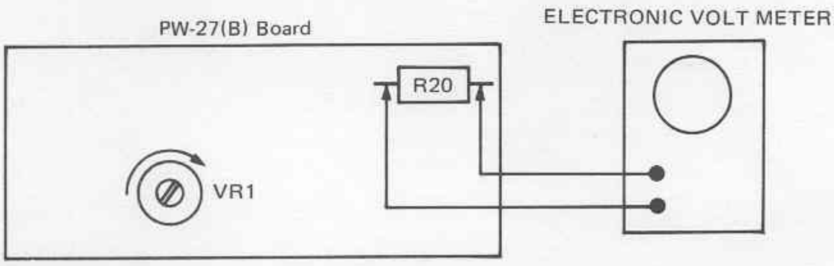


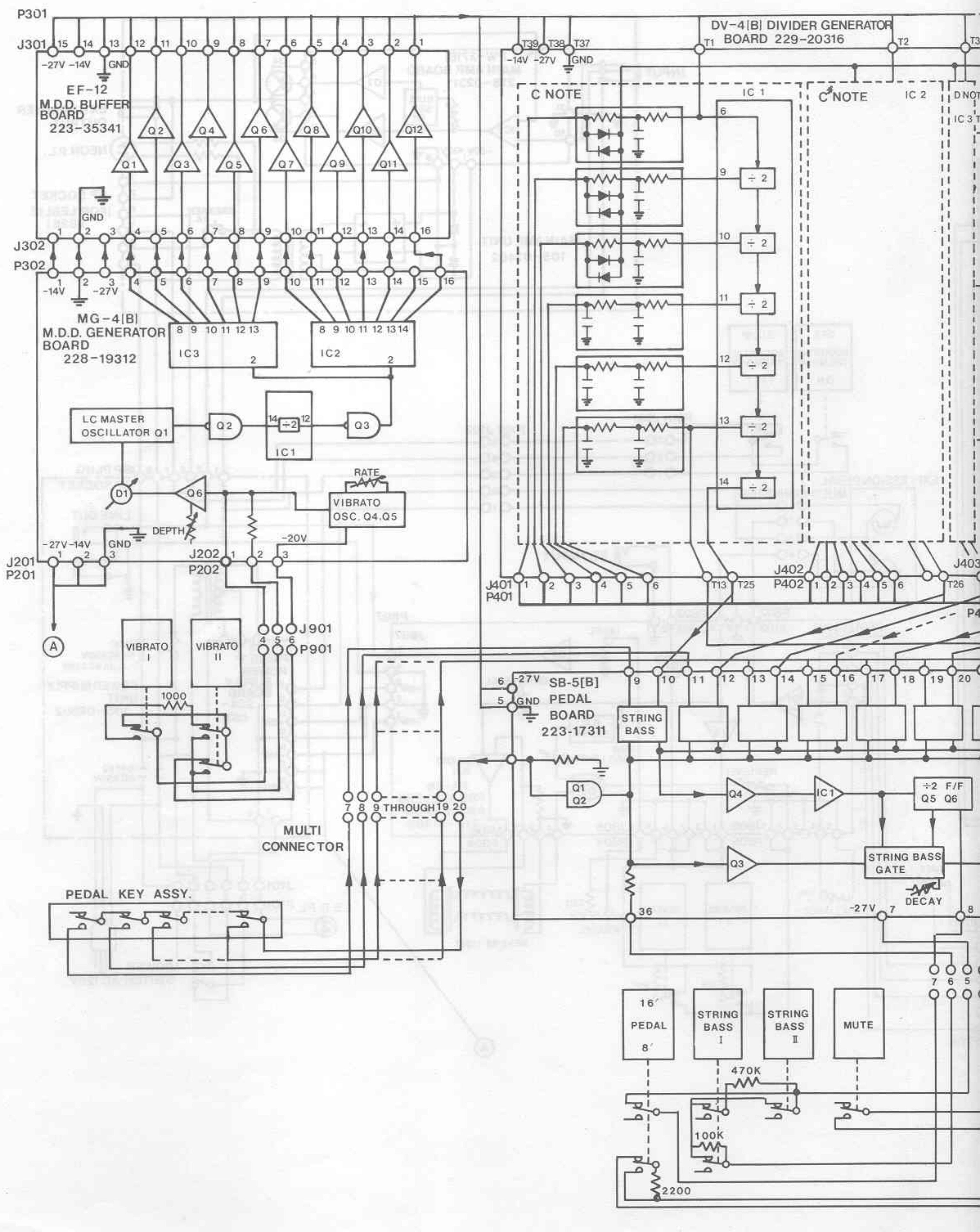
Fig. 11



SECTION III.
DIAGRAMS AND TEXT

3-1 GENERAL

This section contains schematic diagrams and text to illustrate and provide information necessary to proper organ servicing.



P301
J301
-27V -14V GND
EF-12
M.D.D. BUFFER BOARD
223-35341
J302
P302
MG-4[B]
M.D.D. GENERATOR BOARD
228-19312
IC3
IC2
LC MASTER OSCILLATOR Q1
IC1
RATE
VIBRATO OSC. Q4.Q5
DEPTH
-20V
J201
P201
J202
P202
J901
P901
VIBRATO I
VIBRATO II
1000
MULTI CONNECTOR
7 8 9 THROUGH 19 20
PEDAL KEY ASSY.
DV-4[B] DIVIDER GENERATOR BOARD 229-20316
C NOTE
C# NOTE
D NOTE
J401
P401
J402
P402
J403
SB-5[B] PEDAL BOARD 223-17311
STRING BASS
÷2 F/F Q5 Q6
STRING BASS GATE
DECAY
-27V
16' PEDAL 8'
STRING BASS I
STRING BASS II
MUTE
470K
100K
2200

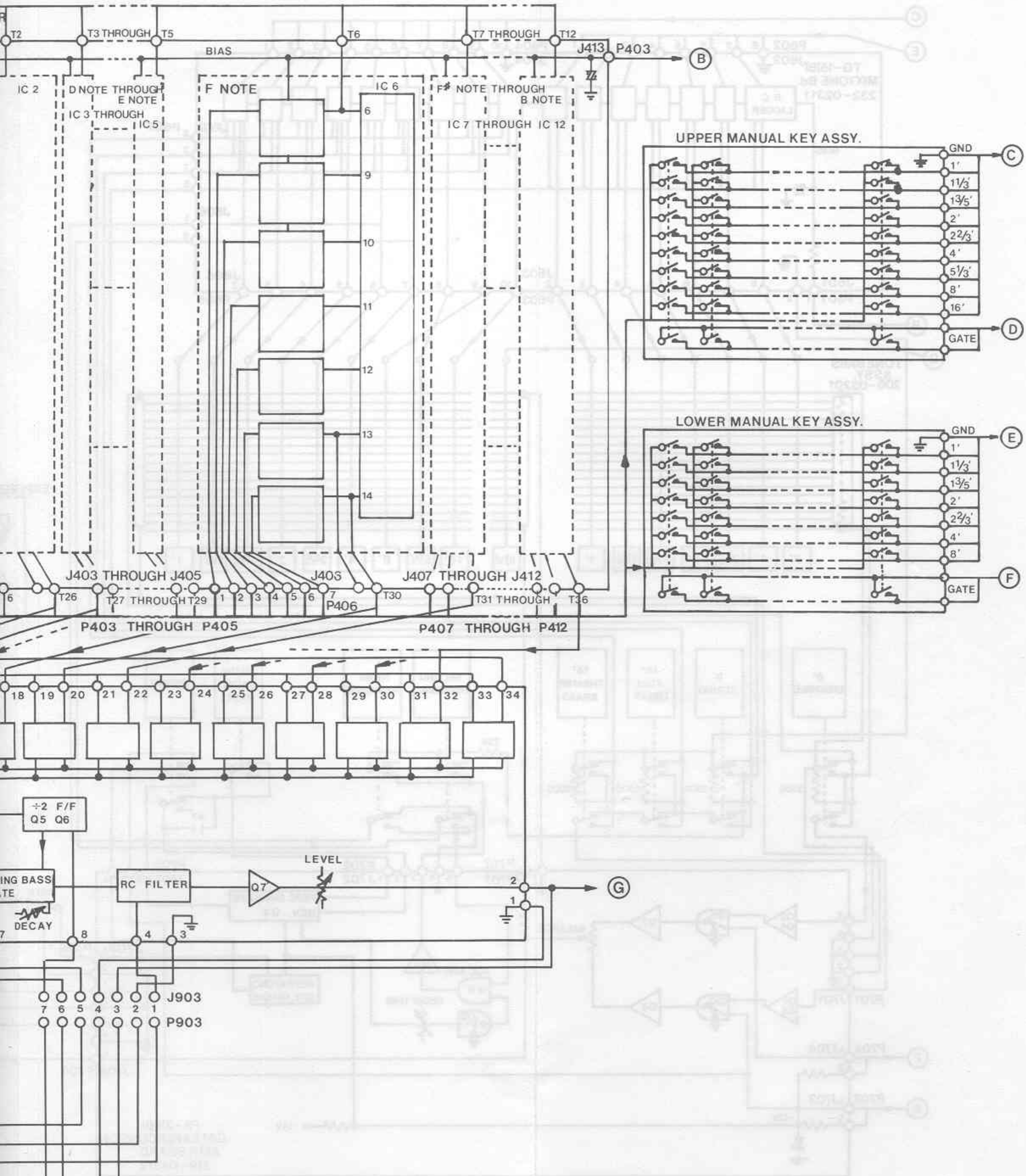


FIGURE 3-1
LOGIC DIAGRAM (2-1)

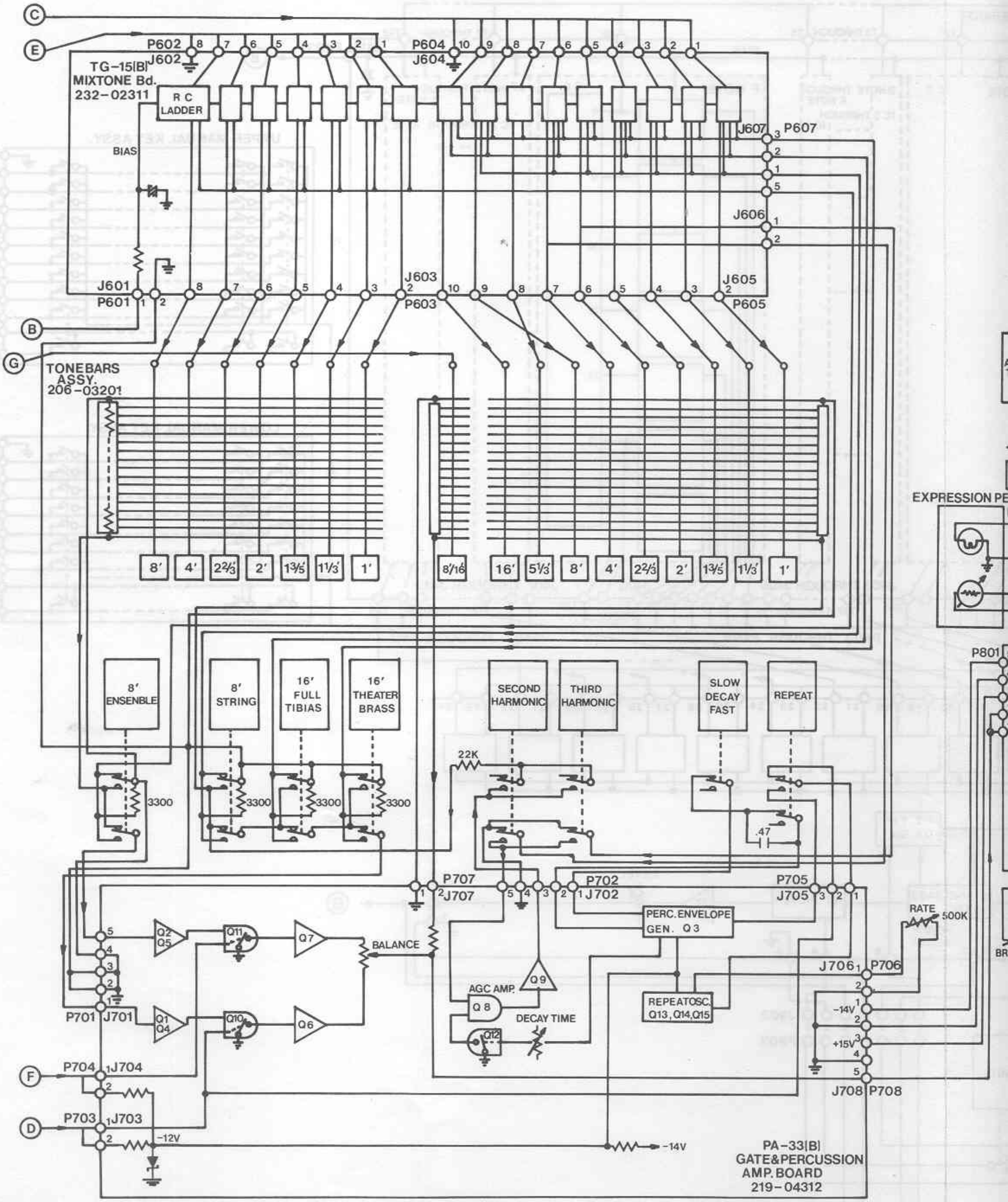
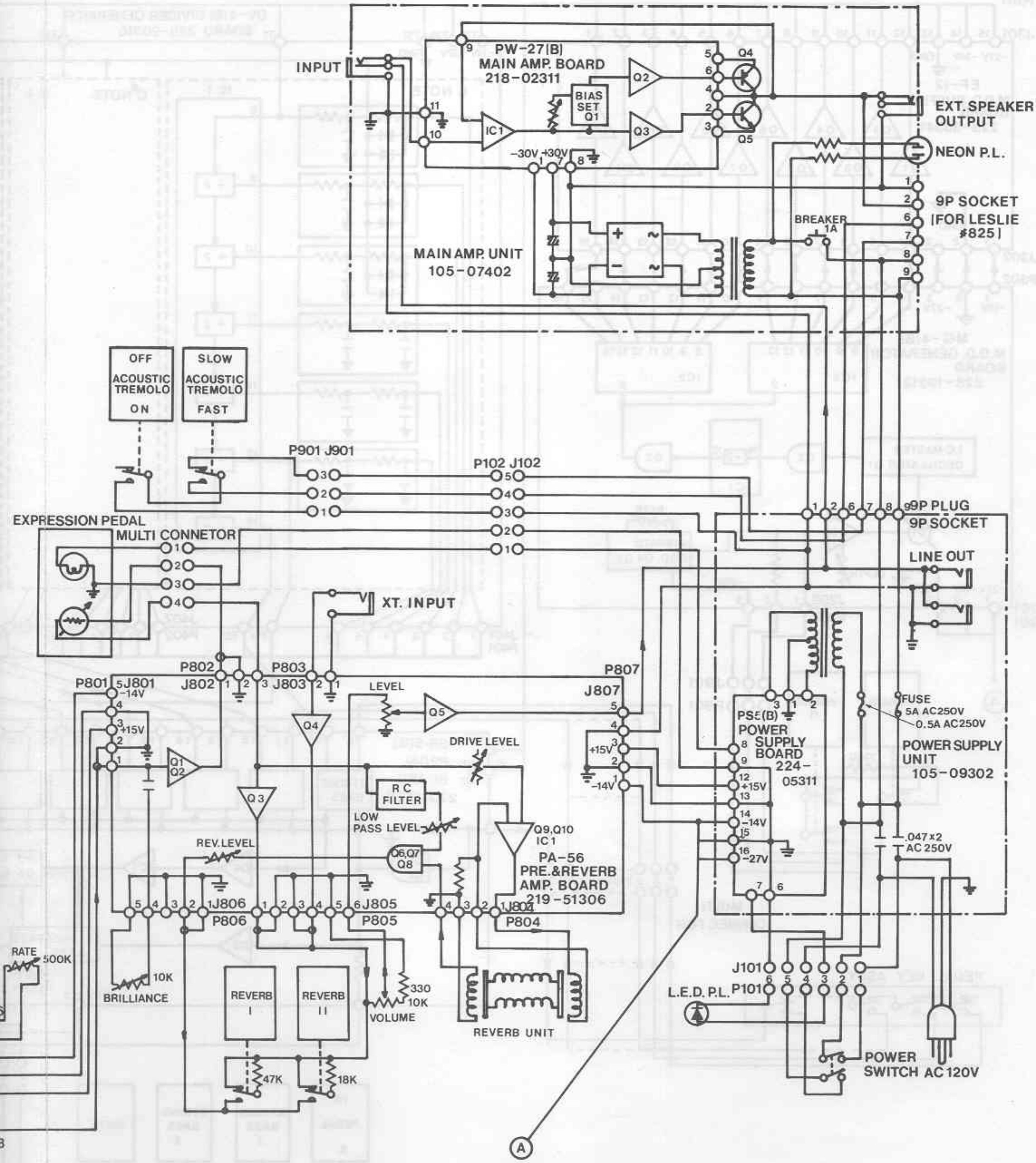
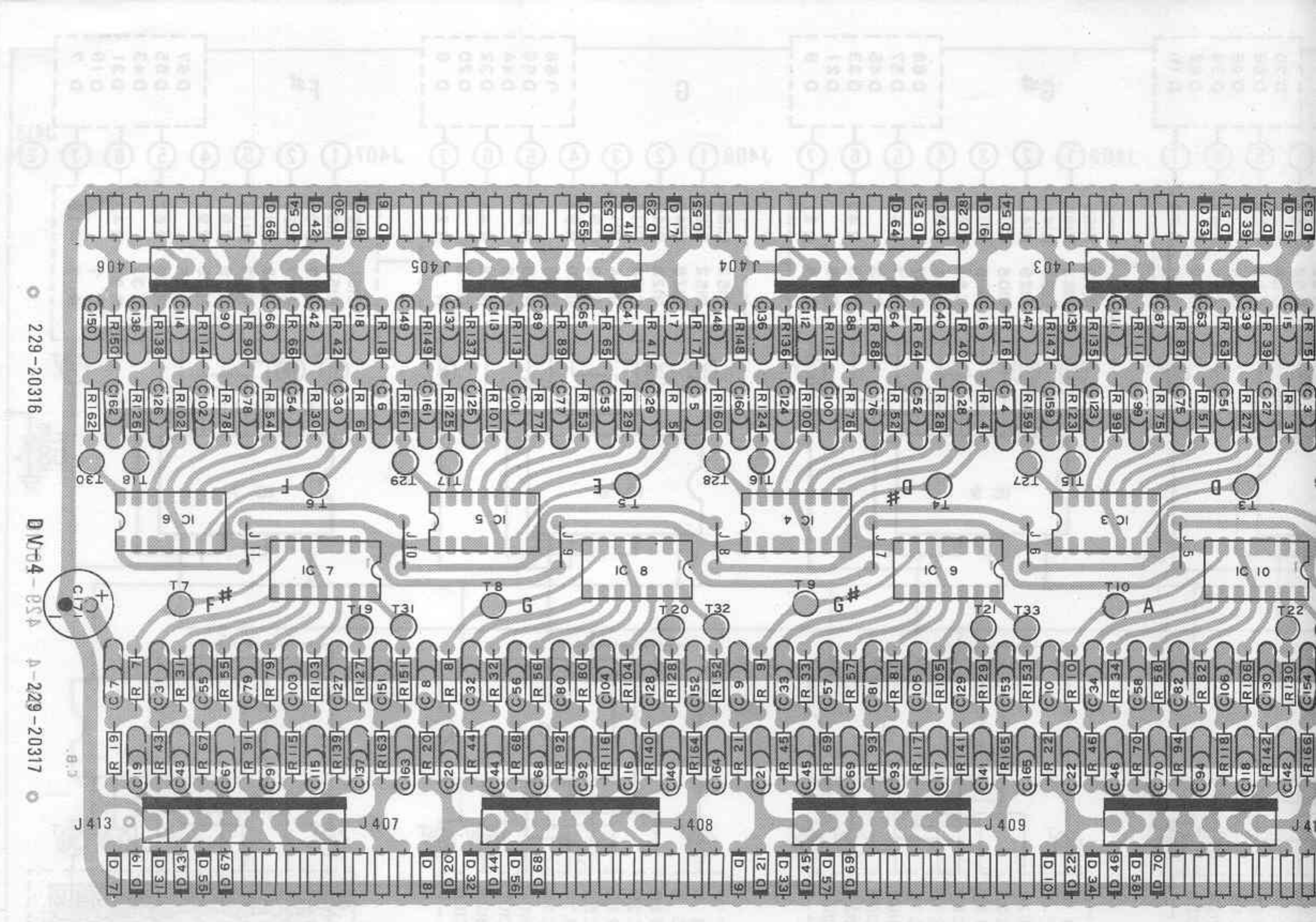


FIGURE 3-2
LOGIC DIAGRAM (2-2)



INPUT
PW-27(B)
MAIN AMP. BOARD
218-02311
BIAS SET Q1
IC1
Q2
Q3
Q4
Q5
EXT. SPEAKER OUTPUT
NEON P.L.
-30V +30V
9P SOCKET (FOR LESLIE #825)
BREAKER 1A
MAIN AMP. UNIT
105-07402
OFF ACOUSTIC TREMOLO ON
SLOW ACOUSTIC TREMOLO FAST
P901 J901
P102 J102
EXPRESSION PEDAL
MULTI CONNETOR
9P PLUG
9P SOCKET
LINE OUT
XT. INPUT
P802 J802
P803 J803
P801 J801
-14V
+15V
LEVEL
Q5
P807 J807
DRIVE LEVEL
RC FILTER
LOW PASS LEVEL
Q6,Q7 Q8
Q9,Q10 IC1
PA-56
PRE.&REVERB AMP. BOARD
219-51306
REV. LEVEL
J806 P806
J805 P805
J804 P804
PS5(B)
POWER SUPPLY BOARD
224-05311
-27V
FUSE
5A AC250V
0.5A AC250V
POWER SUPPLY UNIT
105-09302
.047×2 AC 250V
RATE 500K
10K
BRILLIANCE
REVERB I
REVERB II
47K
18K
330
10K
VOLUME
REVERB UNIT
J101
P101
L.E.D. P.L.
POWER SWITCH AC120V
A



DV-4(B) RC LIST

CAPACITORS

.01	C95, 96
.015	C80 thru 84, 39 thru 94
.022	C10 thru 12, 75 thru 79, 85 thru 88
.027	C8, 9, 34 thru 36, 73, 74, 108, 119, 120
.033	C5 thru 7, 31 thru 33, 104 thru 107, 113 thru 118
.039	C1 thru 4, 29, 30, 101 thru 103, 112
.047	C25 thru 28, 98 thru 100, 109 thru 111
.056	C58 thru 60, 97, 130 thru 132, 141 thru 144
.068	C55 thru 57, 127 thru 129, 137 thru 140
.082	C53, 54, 124 thru 126, 134 thru 136
.1	C49 thru 52, 121 thru 123, 133, 150 thru 156, 162 thru 169

*NOTES All capacitors are in microfarads, ±10% 50 volts.

All resistors are in ohms, ±5%, ¼ watt.

RESISTORS

560	R13 thru 24
1000	R37 thru 48, 61 thru 72
10K	R1 thru 12
22K	R25 thru 36, 49 thru 60
47K	R73 thru 84, 86 thru 88, 94, 97 thru 133, 135, 137 thru 141, 143, 144, 151 thru 156, 162, 167, 168
56K	R85, 89 thru 93, 95, 96, 134, 136, 142, 166
68K	R165
82K	R163, 164
100K	R150

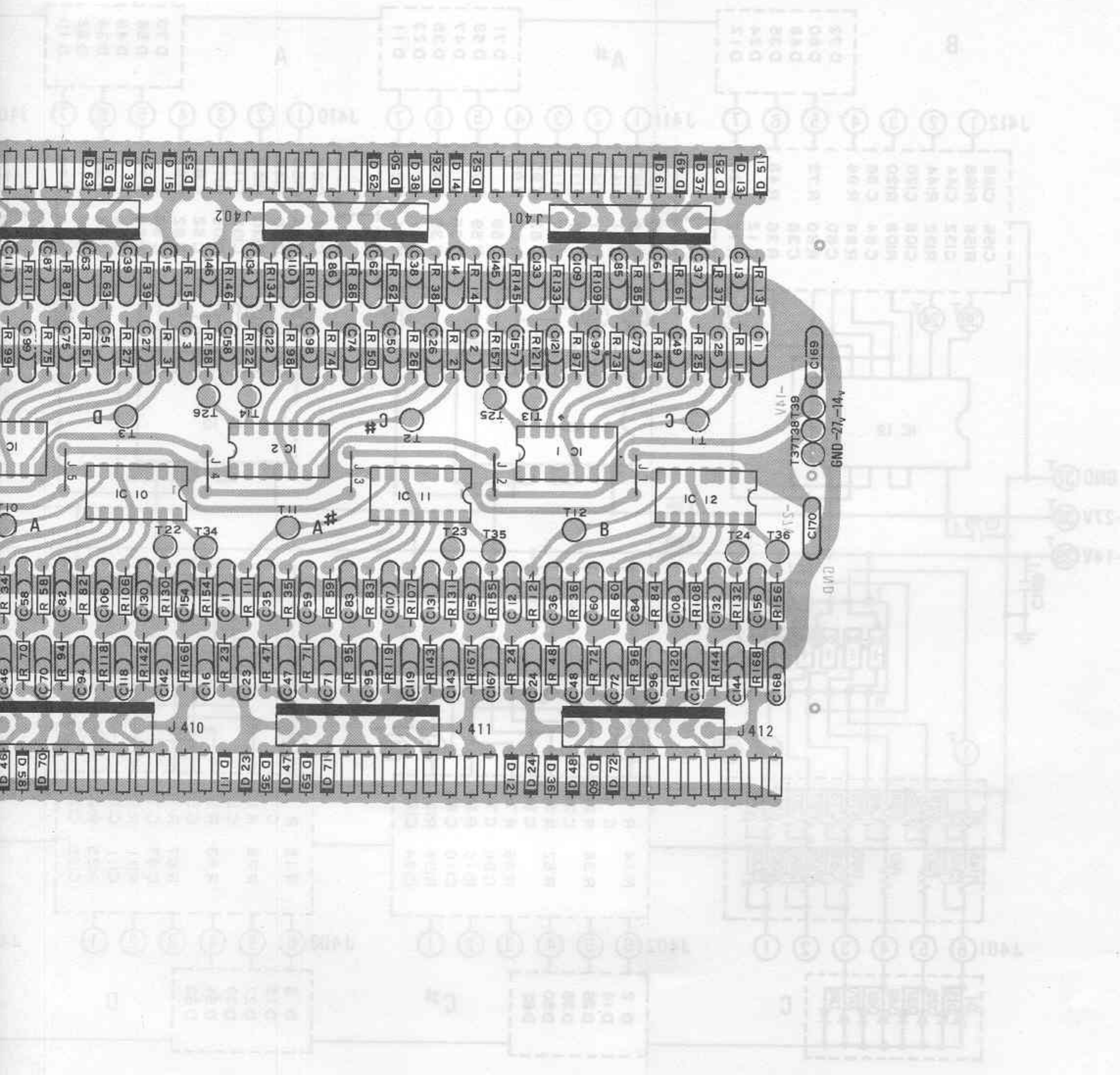
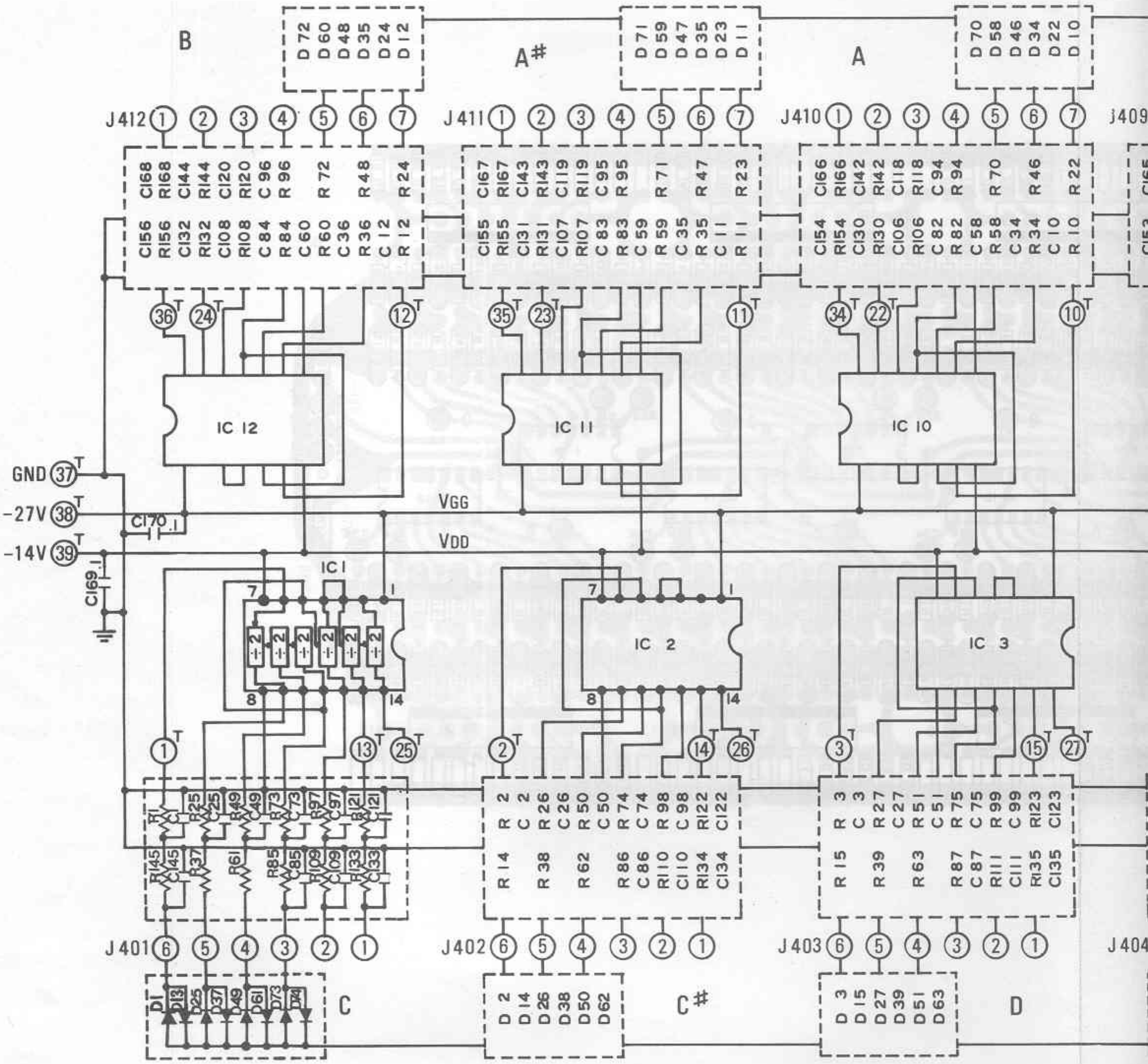


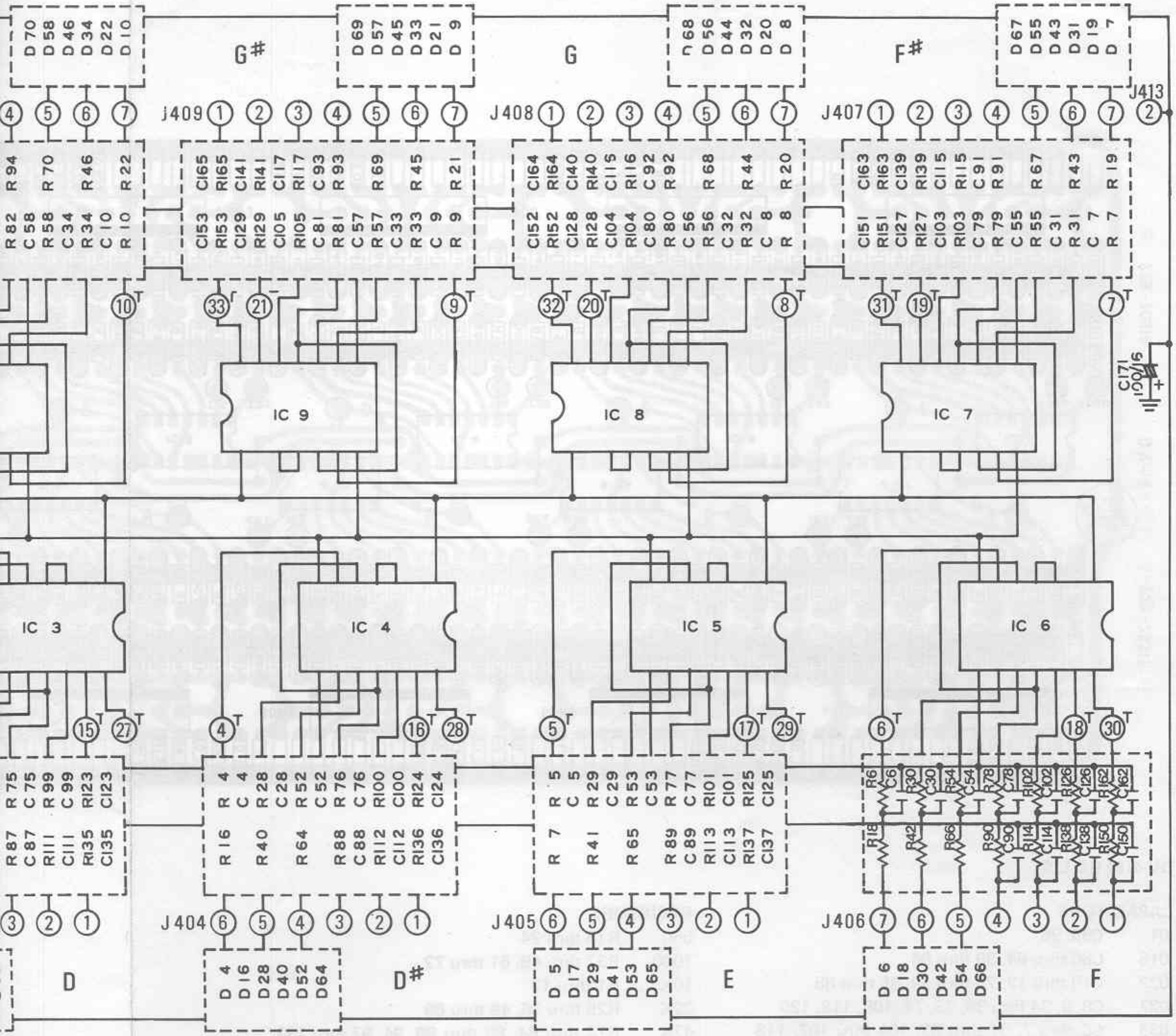
FIGURE 3-3
DV-4B (229-20316)
DIVIDER BOARD LAY OUT
& R.C. LIST



* NOTES
1 D2 THROUGH D74 306-01017 1S2473 or 306-01005 1S1555
IC1 THROUGH IC12, 319-01007 MM5824
2 UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS, ±5%, 1/4WATT.
ALL CAPACITORS ARE IN MICROFARADS, AND
C1 THROUGH C170 ARE USED MYLAR TYPE, ±10%.
3 (1)T SYMBOL DENOTES NUMBERS IN TERMINAL.
(1) SYMBOL DENOTES NUMBERS IN PLUG.

4 C NOTE THROUGH E NOTE ARE 6 STAGES, AND
F NOTE THROUGH B NOTE ARE 7 STAGES.
CURCUITS OF EACH NOTES ARE ALL SIMILARLY.

FIGURE 3-4
DV-4B (229-20316)
DIVIDER BOARD
THEORY



229-20318
229-20218

DIVIDER GENERATOR BOARD
SCHMATIC AND LAYOUT #1

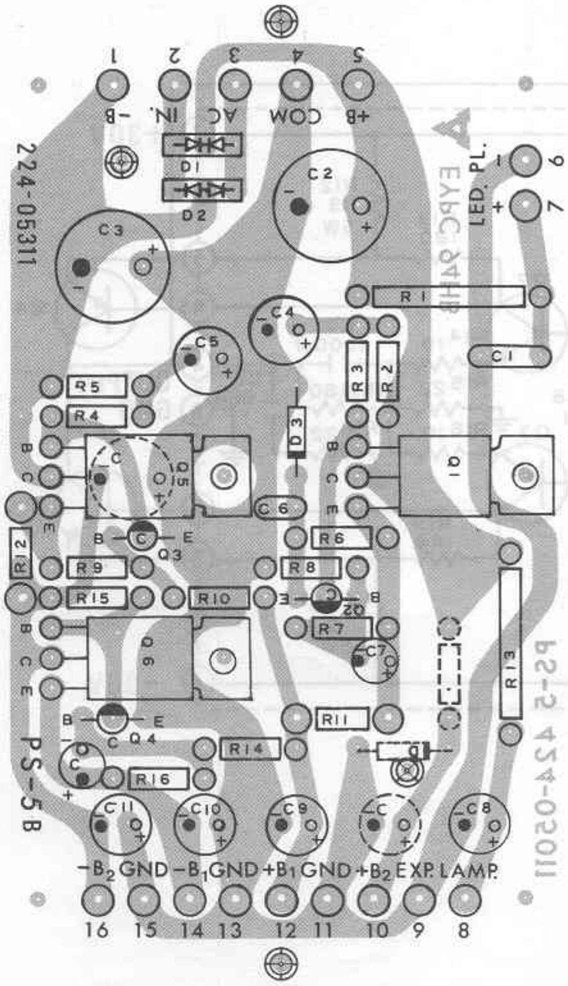
Frequency Divider and Filter

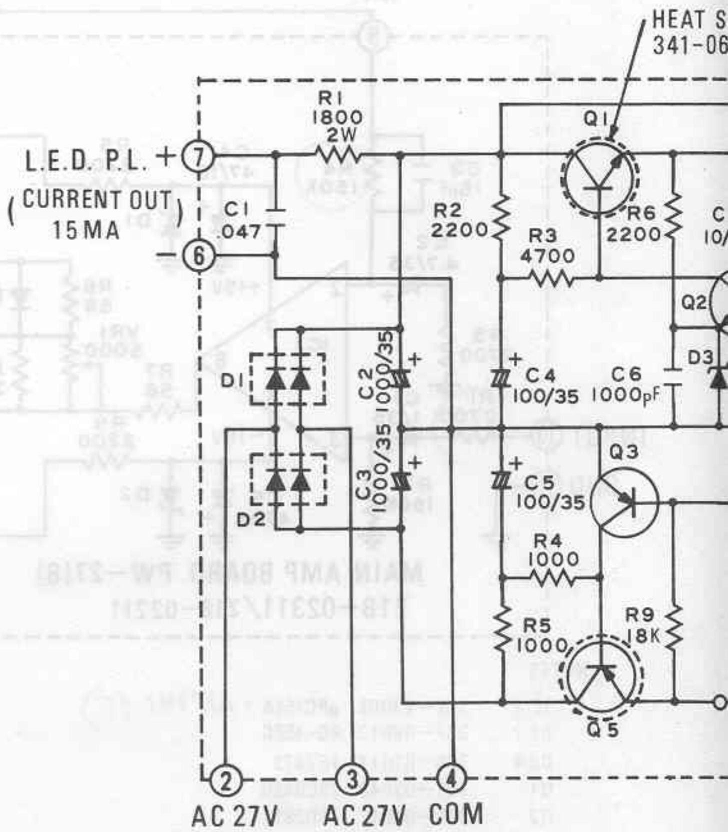
Assembly DV-4 contains twelve (12) IC packages and Sine Wave Filters.

These packages contain all circuitry associated with dividing the top octave frequencies actually used in the organ. The IC is a MOS type enclosed in a dual inline package, and it provides six stages of binary division to produce six octave-related outputs of the tone generator. Each output of the IC is connected a sine wave filter. Three groups of the filters from top octave operate as follows; the square wave from divider is transformed into a triangular wave by CR low pass filter (ex: C1 and R1), and is additionally transformed into similar sine waves by a diode clippers (ex: D1 and D13). Other groups of the filters consist of only CR type with a sloping character of 12 dB per octave. (ex: C73, R73, C85, and R85).

A voltage for a common line of diodes, D1 through D72, is smoothed by C171. It is about −6 volts D.C. and is added to bus bars of the keyboard.

When this voltage is much different from the mean value for the signal of divider out (over 0.3 volt), a key noise will be loud.





• NOTES

1 D1 306-01023 1B2C1
D2 306-01024 1B2Z1
D3 337-02001 02Z-6.2A
Q1 305-03027 2SC1226A
Q2 305-03040 2SC945Q
Q3.4 305-01008 2SA733Q
Q5.6 305 01013 2SA490Y

2 UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS. ±5%.1/4WATT.
ALL CAPACITORS ARE IN MICROFARADS.

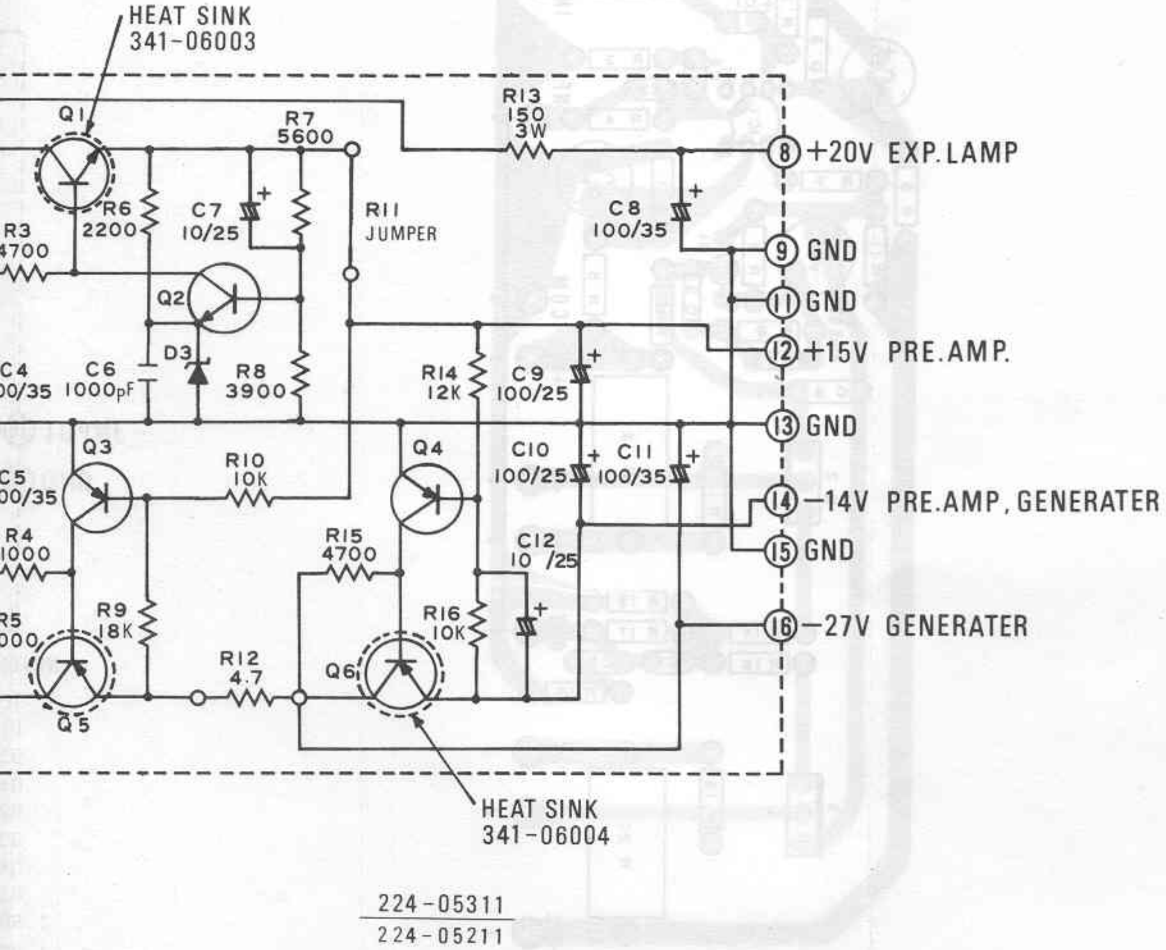
3 (1) SYMBOL DENOTES NUMBERS IN TERMINALS.

PS-5(B) 224-05311
POWER SUPPLY BOARD

This board provides the power supply regulated circuits for the organ circuits.

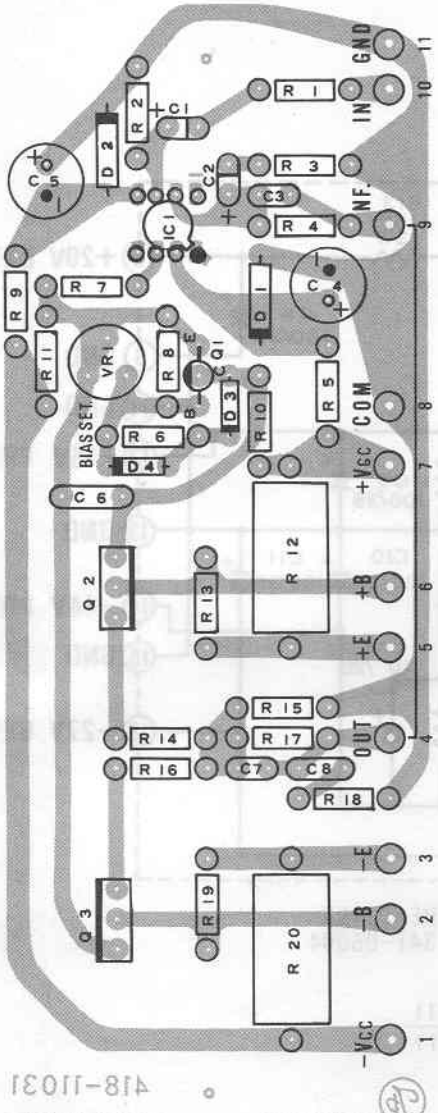
The outputs are unregulated for the LED Pilot light and Expression Pedal light, and the voltage outputs are regulated for the organ circuits. The current is about 15Ma for LED. on terminals 6 and 7, and about 100Ma for the Expression light on terminals 8 and 9. The voltage outputs are +15 volts, on terminal 12, −14 volts on terminal 14, and −27 volts on terminal 16; The output of +15 volts and −14 volts are used for the control and pre-amplifier, and the outputs of −14 volts and −27 volts are used for generators.

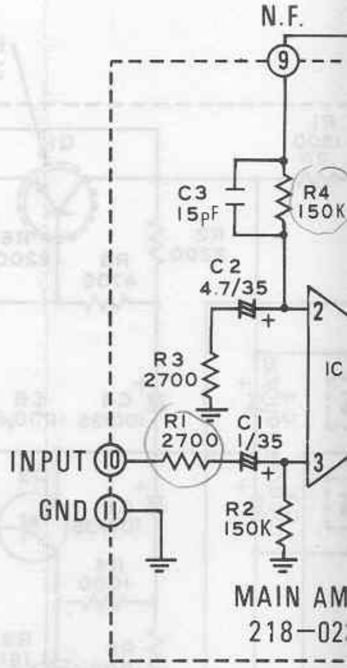
The regulated voltages are referenced from zener diode D3, its voltage is approximately +6 volts. The +15 volts is decided by resistor R7 and R8, the −14 volts is decided by resistor R14 and R16, and the −27 volts is decided by resistor R9 and R10. The resistor R12 protects the transistor Q5 and Q6 from over load.



.1/4WATT.
RADS.
N TERMINALS.

FIGURE 3-9
PS-5(B) (224-05311)
POWER SUPPLY BOARD
LAYOUT & THEORY





*NOTES

1 IC 1 319—23001 μPC
D1,2 337—06013 RD-
D3,4 306—01017 1S2
Q1 305—03040 2SC
Q2 305—04012 2SD
Q3 305—02010 2SB
Q4 305—01009 2SA
Q5 305—04011 2SD

2 RESISTORS(R5,R9,R13,R15,R1

3 UNLESS OTHERWISE SPECIFI
ALL RESISTORS ARE IN OHM
ALL CAPACITORS ARE IN MI

4 ① SYMBOL DENOTES NUM

30 WATT POWER AMPLIFIER MODULE

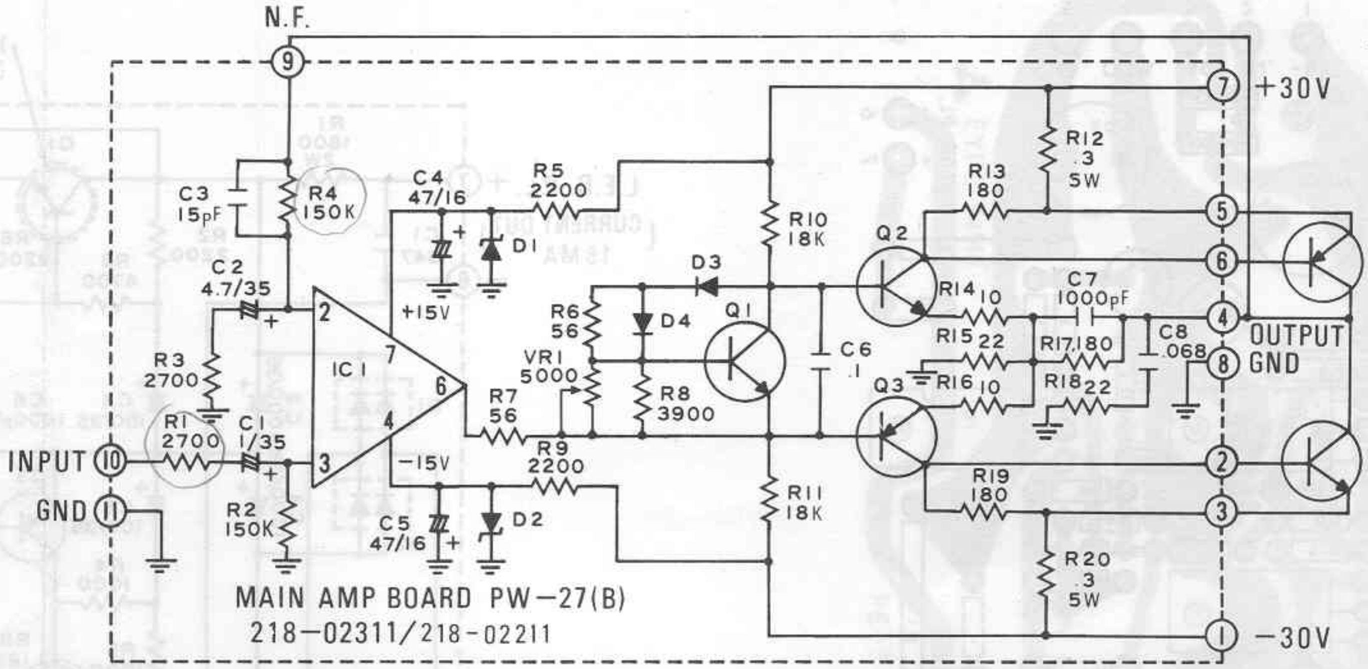
This Amplifier is formed by two (2) stages. The first stage is a differential voltage amplifier, and the second stage is a voltage and power amplifier of the symmetrical inverted darlington type.

A differential amplifier (Operational Amplifier) used for the input circuit keeps the output at D.C. ground by compensating the bias of the output transistors. This circuit makes symmetry-complementary output practical by eliminating the bias problems. I.C. 1 is biased equally to ground with R2 and R4. Since the load is connected to Pin 2 of I.C. 1 through R4, ground potential is achieved at the load.

The I.C. feedback path from the load to Pin 2 of I.C. 1 also presents a convenient way to apply A.C. feedback. The amount of feedback is controlled by R3 and R4 and their ratio determines the overall gain of the amplifier. The very high open loop gain, which permits the large negative feedback, is due to I.C. 1 which operates class A with D.C. to high frequency.

Two diodes, D
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important fu
In order for
drops across
the voltage
plus the dro
through the
this current,
across the Q
of approxim
crossover dis
the voltage
voltage is app
The quiesce
adjusting VF
counterclock

Check R1 skal være 2,7KΩ
-"- R4 -"- 150KΩ



• NOTES

1. IC 1 319-23001 μPC151A = LM741 (S)
   D1,2 337-06013 RD-15EC
   D3,4 306-01017 1S2473
   Q1 305-03040 2SC945Q
   Q2 305-04012 2SD381
   Q3 305-02010 2SB536
   Q4 305-01009 2SA627
   Q5 305-04011 2SD188
2. RESISTORS(R5,R9,R13,R15,R17,R19) ARE ±10%,1/2WATT.
3. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS,±5%,1/4WATT.
   ALL CAPACITORS ARE IN MICROFARADS.
4. ① SYMBOL DENOTES NUMBERS IN TERMINALS

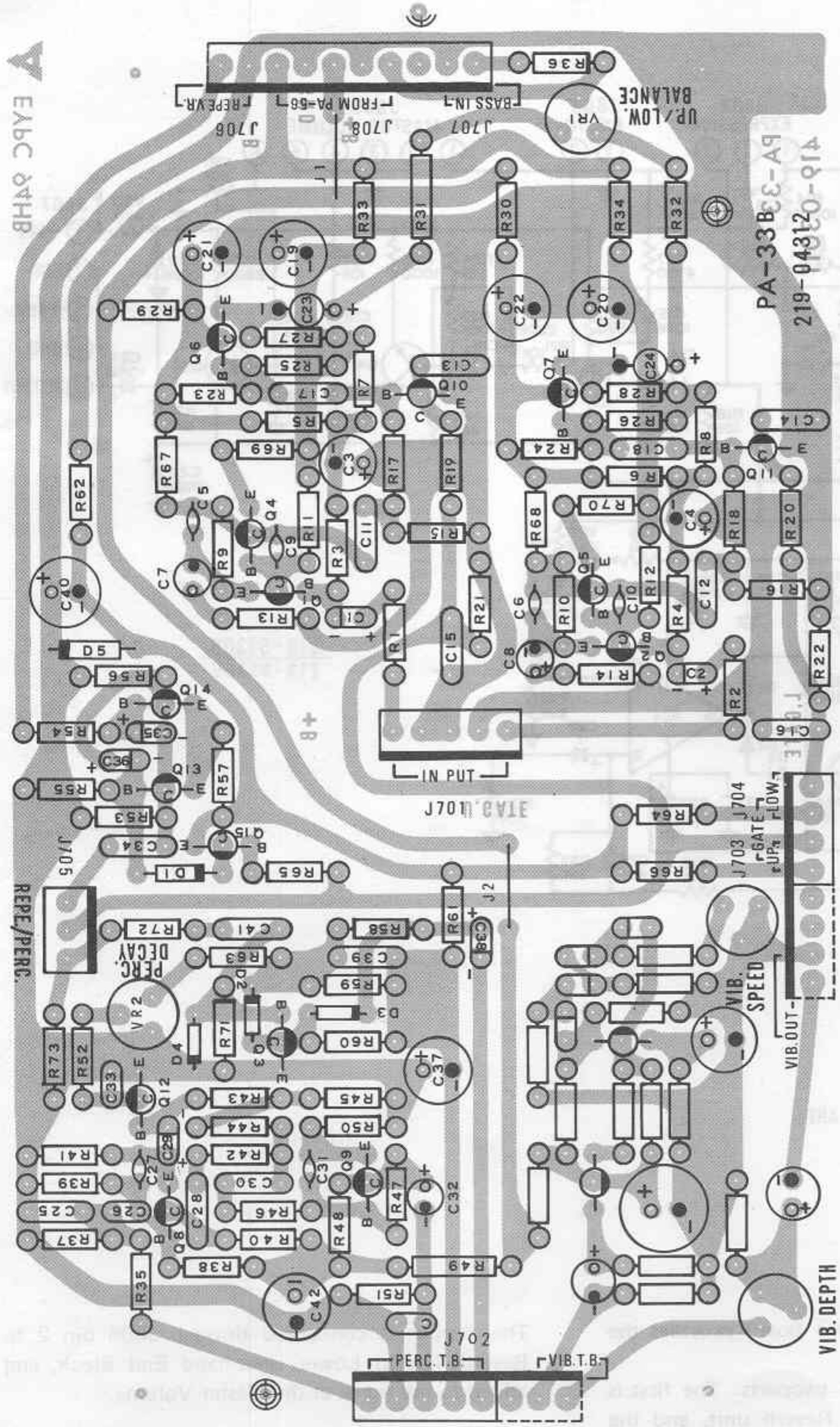
Two diodes, D3, and D4, and transistor Q1 represent part of the load seen by I.C. 1 and perform the important function of biasing the output transistors. In order for Q2 and Q3 to be biased on, the voltage drops across collecter to emitter of Q1 must equal the voltage drops across the emitters Q2 and Q3 plus the drops across R14 and R16. The current through the Q1 is determined by R10 and R11, and this current, in turn, determines the voltage drop across the Q1 by VR1. A Q4, Q5 quiescent current of approximately 100Ma is necessary to prevent crossover distortion, then this current determines the voltage drop across R12, or R20, and the voltage is approximately 35 Mv.

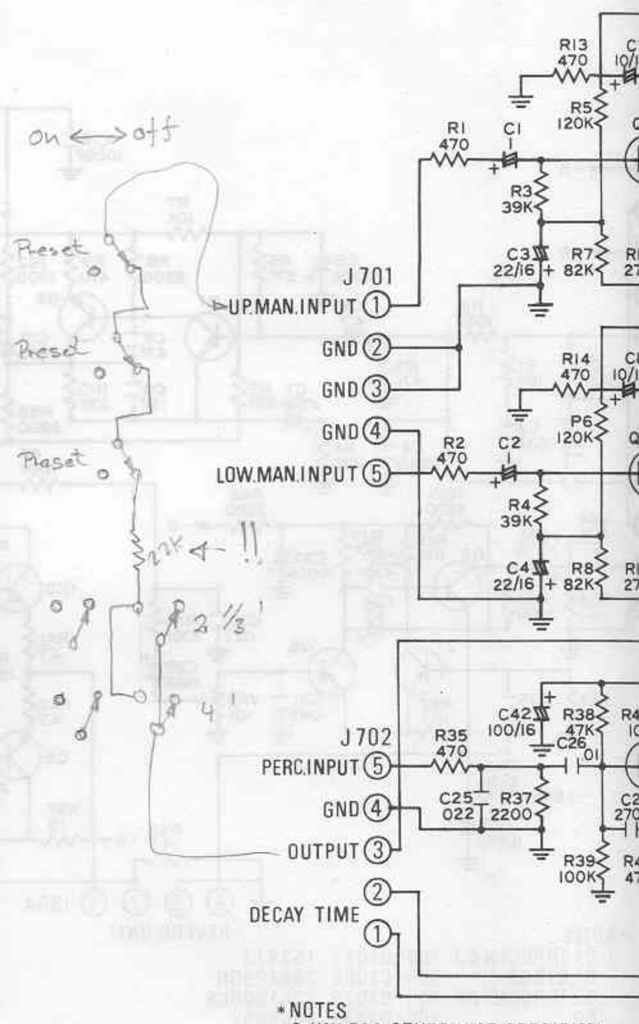
The quiescent current must be determined by adjusting VR1 to clockwise completely, and then counterclockwise to achieve 100Ma.

Transistors, Q2 and Q4, Q3 and Q5, are Inverted Darlington connected. Q2 and Q4 is like a NPN transistor, Q3 and Q5 is like a PNP transistor.

RC pad R18, and C8 across the load provides high frequency stabilization. C7 is high frequency compensation of second stage amplifier, and C3 is high frequency compensation of overall amplifier.

FIGURE 3-10
30W POWER AMP MODULE
(218-02311)
LAYOUT & THEORY





*NOTES
2 UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS, ±5%,
ALL CAPACITORS ARE IN MICROFARA
USED TANTALUM.
3 ① SYMBOL DENOTES NUMBERS IN

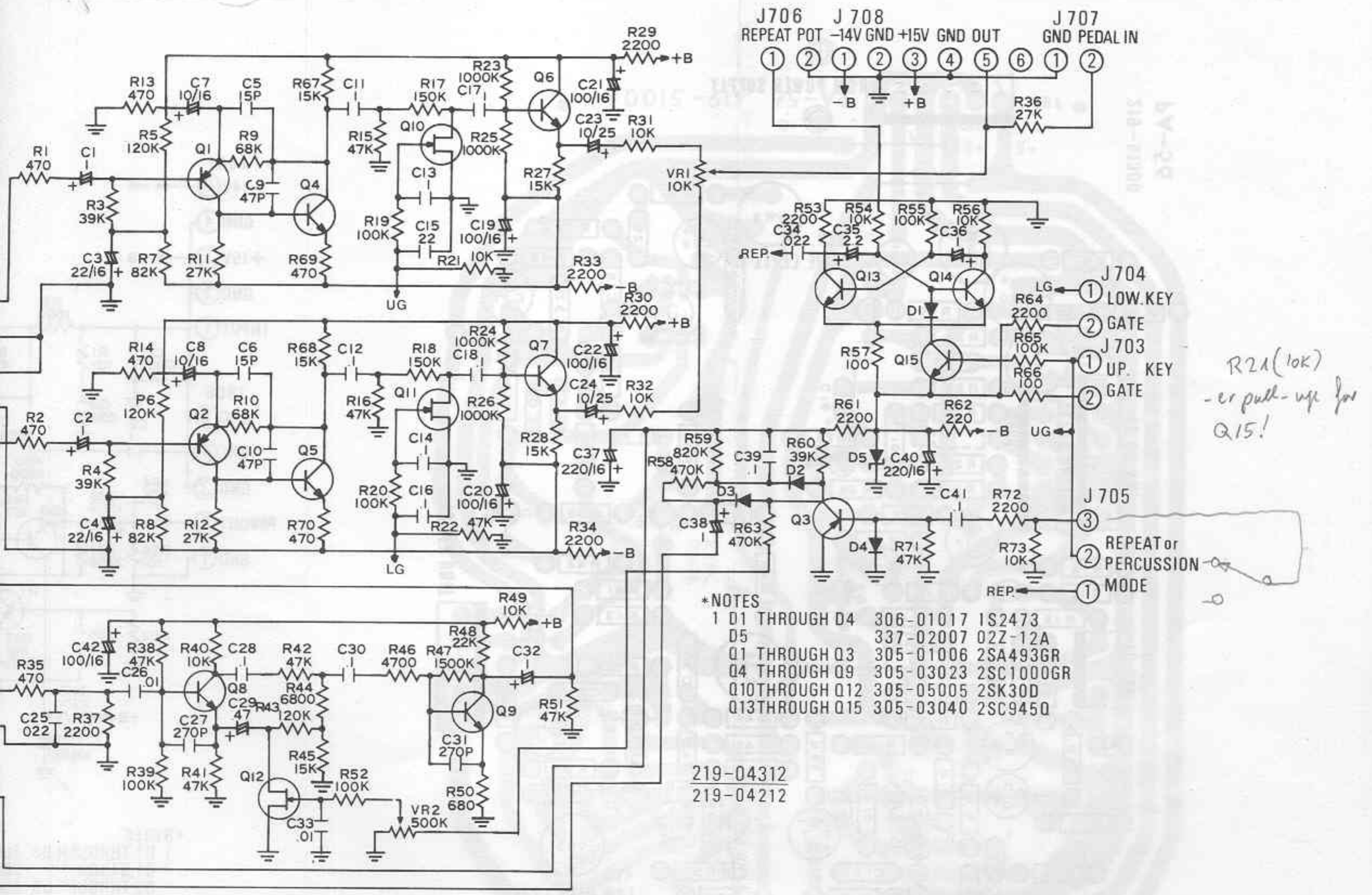
PA-33(B) 219-04312
GATE & PERCUSSION AMP. BOARD

This board will be described in three sections: Section 1 will be the Gate Amplifiers for Upper Manual and Lower Manual, Section 2 will be the Voltage controlled amplifier for Percussion, and Section 3 will be the repeat oscillator for the percussion.

1. The signals is applied to J701 from Presets Tabs in Lower left-hand End Block. The signal of Upper Manual, (included Percussion), comes pin 1 of J701, and the signal of Lower Manual comes pin 5 of J701. These signals are amplified by Q1, and Q4, or Q2 and Q5, and these amplified signals are normally grounded by Q10 or Q11, and then if Manual Keys will be downed, through J703 or J704, the negative D.C. voltage is connected to UG point or LG point, and Q10 or Q11 is turned off. The signals

appear th
emitter fo
are balan
through J7

2. The se
Percussion
from Percu
and pin 5
The signa
controlled
amplified s
and to inp
The envelo
Q3, Its d
through J
and pin 2
and if pin
decay tim
percussion



HERWISE SPECIFIED:
ORS ARE IN OHMS, ±5%, 1/4WATT.
TORS ARE IN MICROFARADS; AND 1μF THROUGH 4.7μF ARE
ALUM.
L DENOTES NUMBERS IN PLUG.

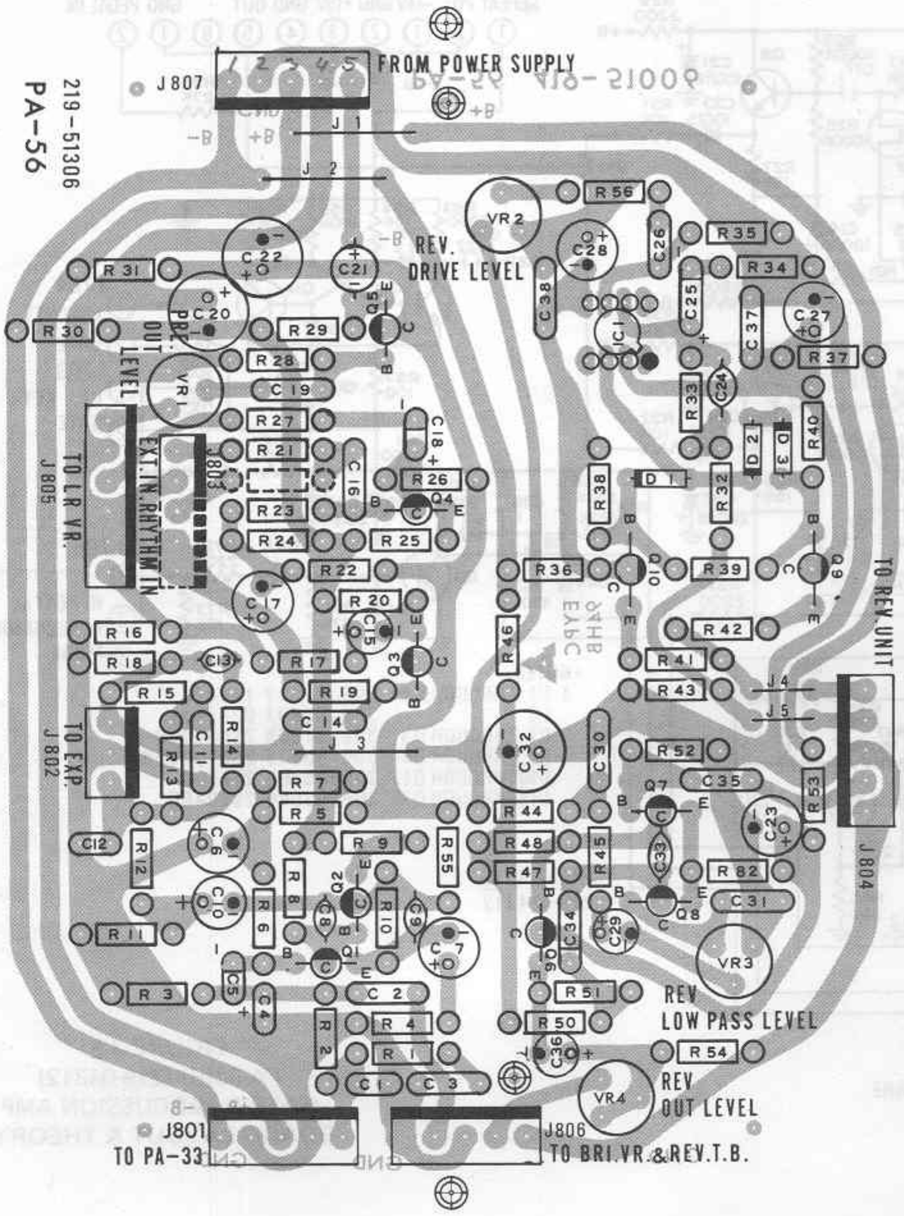
FIGURE 3-5
PA-33(B) (219-04312)
GATE & PERCUSSION AMP
BOARD LAYOUT & THEORY

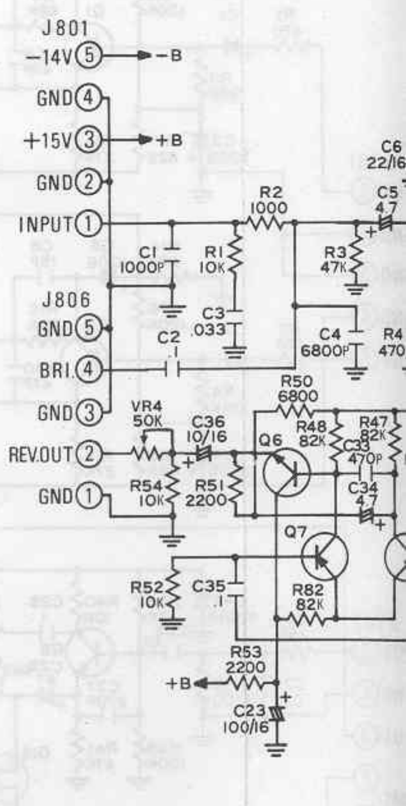
appear through Q6 or Q7 which is used as an emitter follower. The signals gated and amplified are balanced by VR1, and added Pedal signal through J707, and exit at J708 pin 5.

2. The second section of this board provides the Percussion signals. These signals are applied to J702 from Percussion Tabs in Lower left-hand End Block, and pin 5 is the input and pin 3 is the output. The signal is amplified by Q8, which gain is controlled by Q12. Q9 is buffer amplifier, and these amplified signal provide to add the Tone Bars signals, and to input the upper manual input in J701.
The envelope of percussion signals is generated by Q3, Its decay time is controlled by Decay Tab through J702 pin 1 and pin 2 is switched; If pin 1 and pin 2 will be connected, the decay time is slow, and if pin 1 and pin 2 will be not connected, the decay time is fast. VR2 controls the off point of percussion signals.

If an upper manual key is depressed, the negative D.C. voltage is connected to J705 through Repeat Tab, and this voltage triggers Q3. Q3 is turned on. and charges up C38 or C39. This charging controls the envelope of percussion.

3. The third section of this board provides the repeat oscillator. The oscillator used is the self running multi vibrater type, Q15 is normally off, and the oscillator is stopped. If upper manual key is depressed, the negative D.C. voltage is connected to the base of Q15 through J703, and Q15 is turned on, and the oscillator runs. This output of osc. is connected J705 pin 3 through the Repeat Tab in Lower left-hand End Block. This output pulse triggers the transistor Q3, and then the percussion signals is repeated automatically. The repeat rate of this oscillator is controlled by Repeat Rate Pot, In Lower right-hand End Block through J706 in 1 and pin 2.



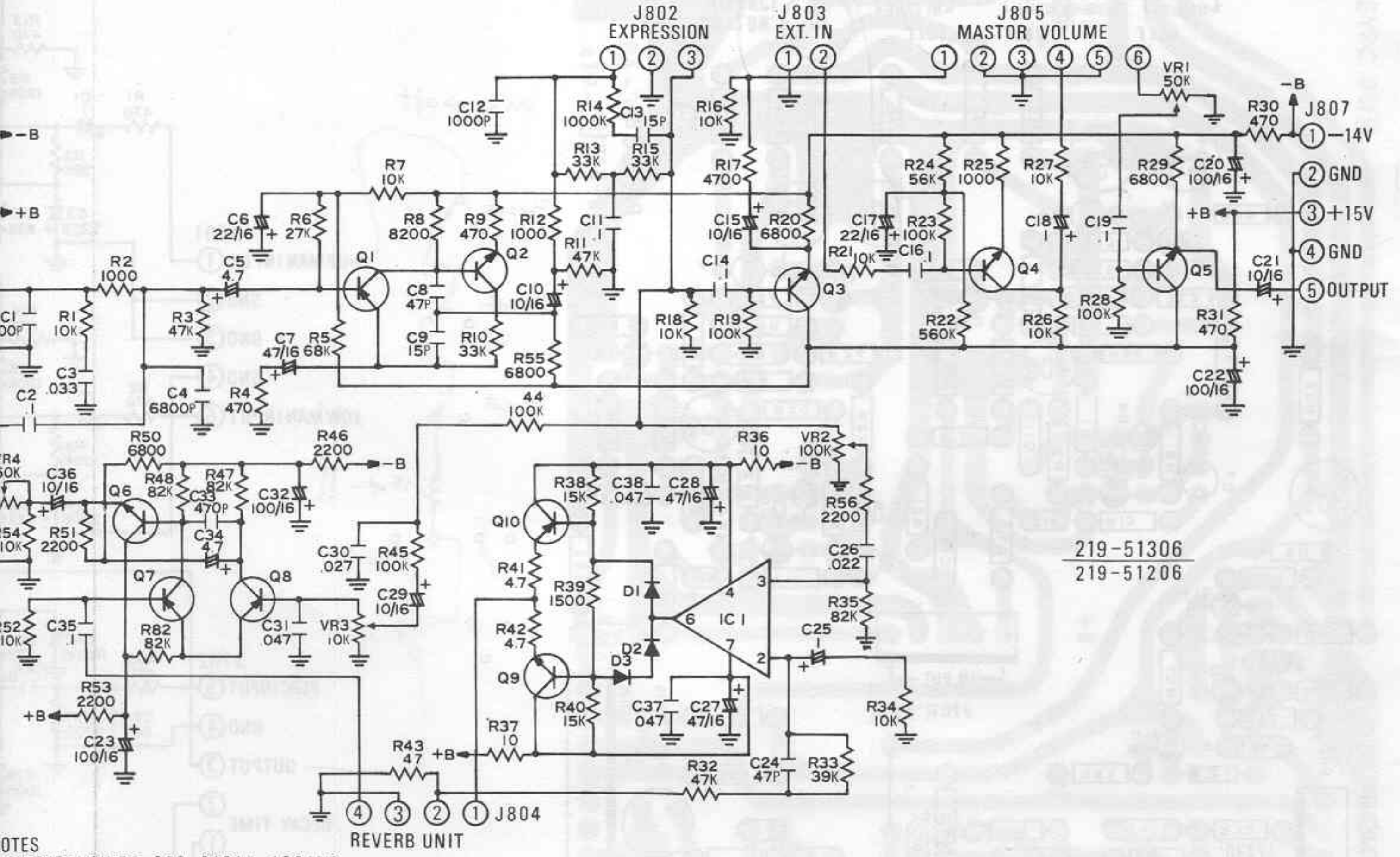


*NOTES
1 D1 THROUGH D3 306-01017
Q1,Q7&Q8 305-01006
Q2 THROUGH Q6 305-03023
Q9 305-03041
Q10 305-01014
IC1 319-23001
2 UNLESS OTHERWISE SPECIFI
ALL RESISTORS ARE IN OHM
ALL CAPACITORS ARE IN MI
USED TANTALUM.
3 ① SYMBOL DENOTES NUMB

PA-56 219-51306
PREAMP & REVERB AMPLIFIER BOARD

This board will be described in two sections: Section 1 will be the Pre Amplifier for the Expression and the Output of The Main Amplifier and Line. Section 2 will be the Reverb Amplifier.

1. The signals from PA-33(B) and the power supply to PA-33(B) are connected to J801. This signal is amplified by transistors Q1 and Q2, and connected to Expression Pedal through J802, and the volume of this signal is controlled by Exp. Pedal. This signal through transistor Q3 is added to Ext. Input signal amplified by Q4 on Master Volume in Lower right-hand End Block, and the signal is output through Q5, its level set by VR1. The Brilliance Pot. is connected to J806 pin 4, The Brilliance Pot. is located on Lower right-hand End Block.



OTES
D1 THROUGH D3 306-01017 1S2473
Q1,Q7&Q8 305-01006 2SA493GR
Q2 THROUGH Q6 305-03023 2SC1000GR
Q9 305-03041 2SC509Y
Q10 305-01014 2SA509Y
IC1 319-23001 μPC151A
UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS, ±5%, 1/4 WATT.
ALL CAPACITORS ARE IN MICROFARADS, AND 1μF THROUGH 4.7μF ARE USED TANTALUM.
① SYMBOL DENOTES NUMBERS IN PLUG.

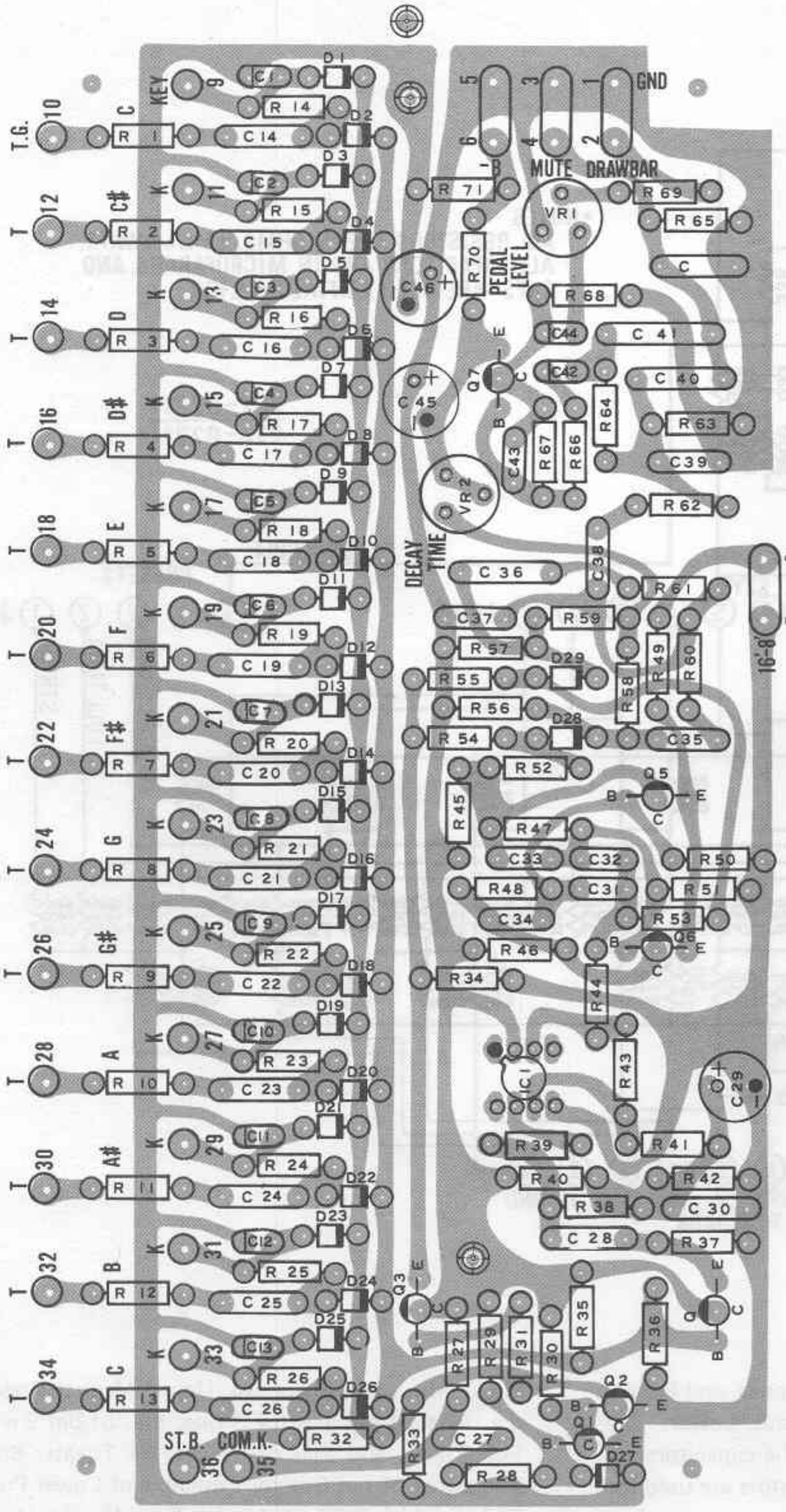
2. The second section of this board provides the reverbration signal.

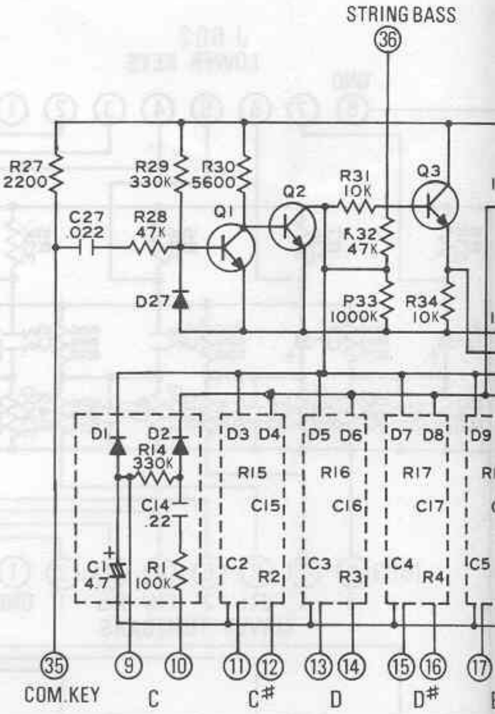
This section is formed from twoparts: The first is the amplifier drive for the Reverb unit, and the second is the amplifier to pickup the Reverb unit. The drive amplifier Feeds the current drive type I.C. 1, Q9, and Q10. That level setting is controlled by VR2. The Resistor R43 provides feedback current. The pickup amplifier is formed by the differential amplifier Q6 through Q8. The low frequency passed filter is formed by R44, R45, VR3, C30, and C31 And this level is controlled by VR3. The output level is controled by VR4. The Reverb Unit is connected through J804.

The output is connected through J806 pin 2 to Reverb Tab in Lower right-hand End Block, and added to the signal at the Master Volume.

The connector J805 is for Master Volume, and The connector J807 is for the output and the power supply connections.

FIGURE 3-6
PA-56 (219-51306)
PRE. & REVERB AMP BOARD
LAYOUT & THEORY





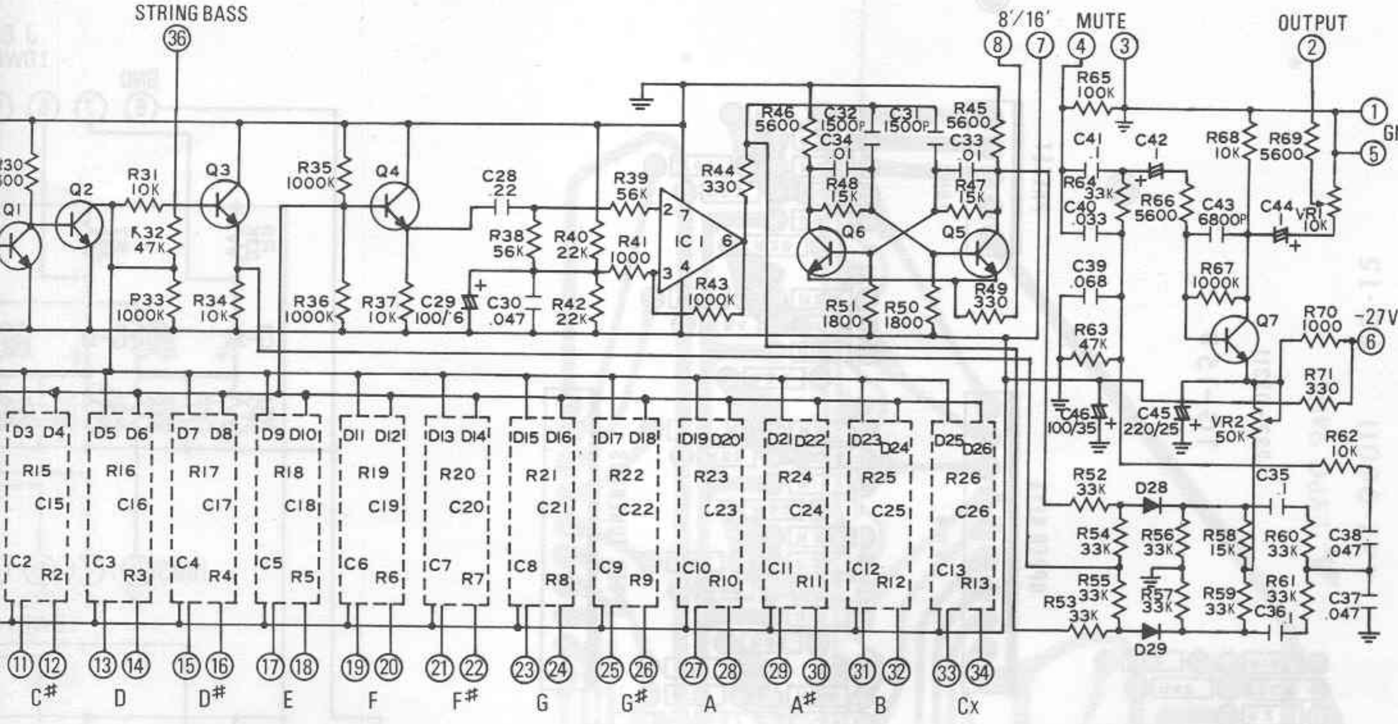
* NOTES
1 D1 THROUGH D29 306-01017 1S2473
Q1 THROUGH Q6 305-03002 2SC828Q o
Q7 305-03023 2SC1000G
IC1 319-23001 μPC151A
2 UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS, ± 5%, 1/4
ALL CAPACITORS ARE IN MICROFARADS; A
3 ① SYMBOL DENOTES NUMBERS IN TER
[ ] SYMBOL DENOTES SAME CIRCUIT.

SB-5(B) 223-17
PEDAL BOAR

This board p
Signals with sus

The clocks fr
input on termi
T22, T24, T26
Keys are conne
T15, T17, T19,
and T35 The
This Pedal Ke
Select, and 1 c

This section i
other notes are
the terminal T
and the capaci
R27. The curr
Q1 and Q2
capabilities of
and D25, befor
This envelope
D1 and R33 o
Bass Tabs in L
the envelope of



H D29   306-01017 1S2473
H Q6   305-03002 2SC828Q OR 305-03040 2SC945Q
305-03023 2SC1000GR
319-23001 μPC151A
HERWISE SPECIFIED:
TORS ARE IN OHMS, ± 5%, 1/4WATT.
TORS ARE IN MICROFARADS; AND 1μF THROUGH 4.7μF ARE USED TANTALUM, ±10%.
L DENOTES NUMBERS IN TERMINALS.
L DENOTES SAME CIRCUIT.

SB-5(B) 223-17311
PEDAL BOARD

This board provides the 13 Pedal (Bass) Notes Signals with sustain (String Bass) or without Sustain.

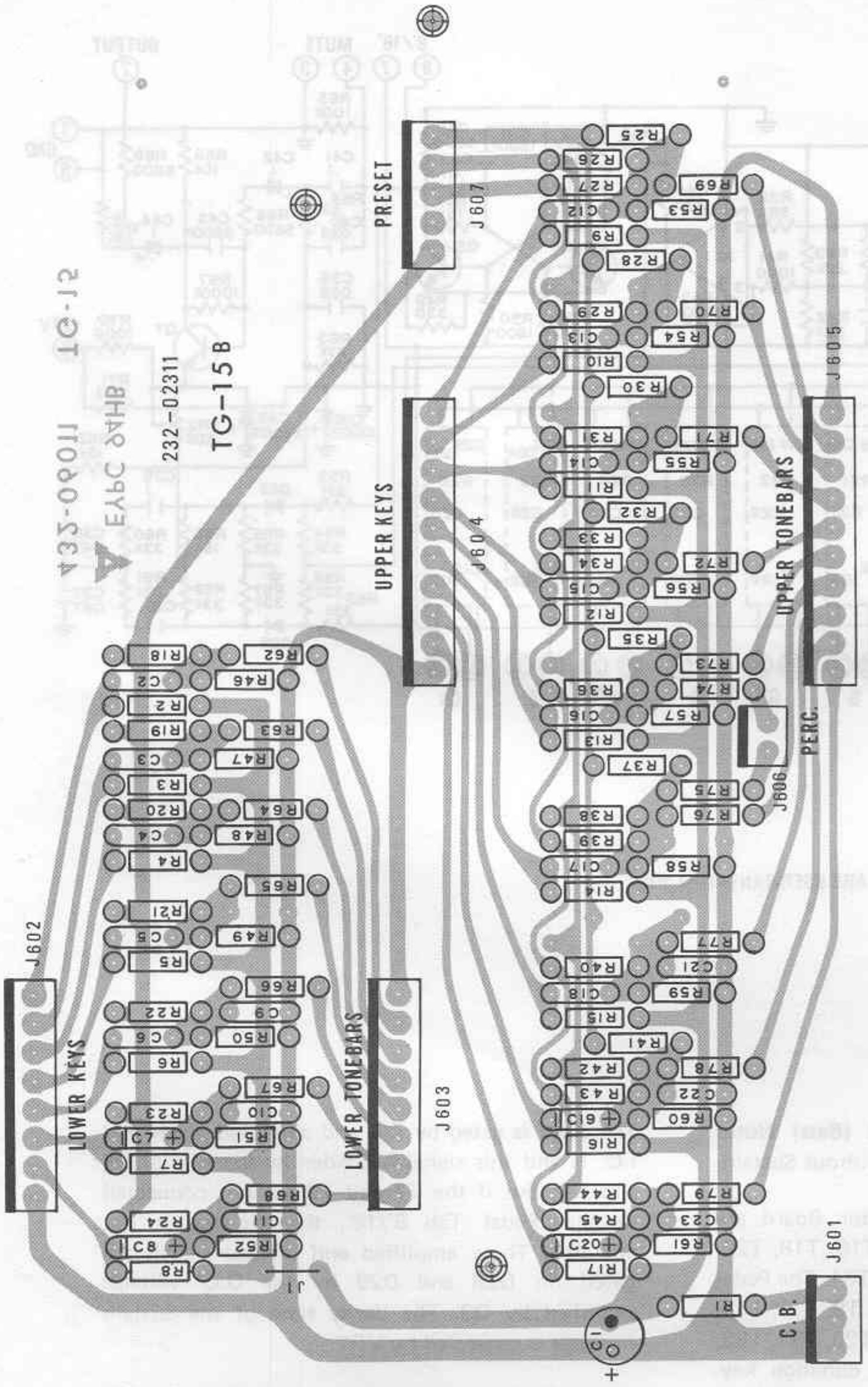
The clocks from DV-4(B) Generator Board are input on terminals T10, T12, T14 T16, T18, T20, T22, T24, T26, T28, T30, T32, and T34. The Pedal Keys are connected on the terminals T9, T11, T13, T15, T17, T19, T21, T23, T25, T27, T29, T31, T33, and T35 The terminal T35 is for common key. This Pedal Keyer assembly is wired with High Note Select, and 1 contact of key connected to common.

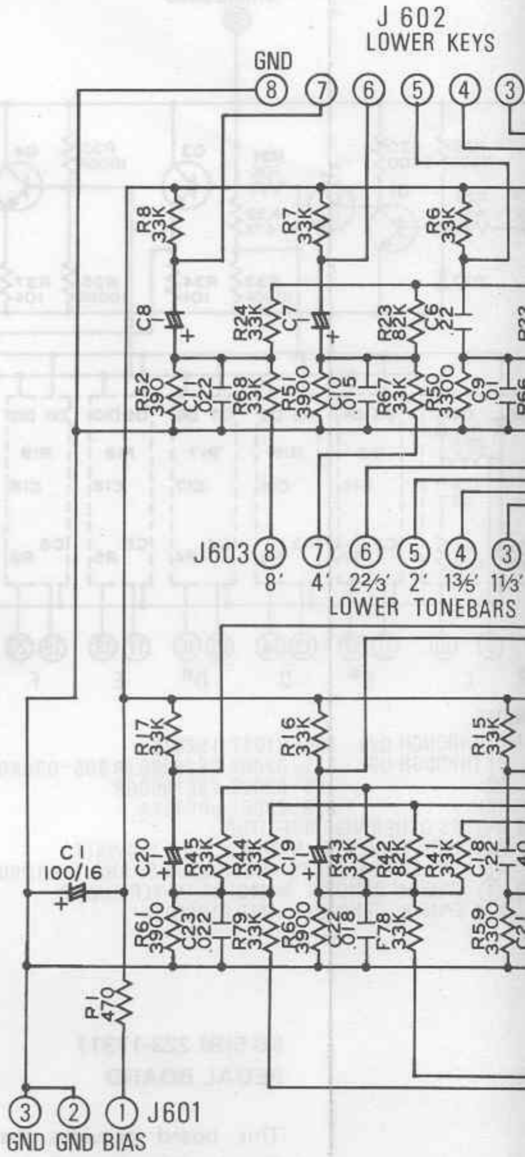
This section is illustrated by only one note, the other notes are all as same. If Pedal key is depressed, the terminal T9 is connected to the common T35, and the capacitor C1 is charged up through resistor R27. The current through R27 switches transistors Q1 and Q2 to turned on, and discharges all capabilities of capacitors through diode, D1, D3, — and D25, before the capacitor C1 will be charged up. This envelope of the discharging capacitors through D1 and R33 or R33 and R31 added through String Bass Tabs in Lower right-hand End Block provides the envelope of the sustain.

The clock is gated by D2, and amplified by Q4 and I.C. 1, and this signal is divided by flip-flop of Q5 and Q6; But if the T7 and T8 are not connected through Pedal Tab 8'/16', the flip-flop is not operated. These amplified and divided signals are gated on D28 and D29 by the D.C. voltages amplified by Q3. The decay time of the Sustain envelope is controled by VR2.

Next, those gated signals are amplified by Q7, filtered, and output to Pedal Tone Bar on Terminal T2, and its output level is controled by VR1.

FIGURE 3-7
SB-5(B) (223-17311)
PEDAL BOARD
LAYOUT & THEORY



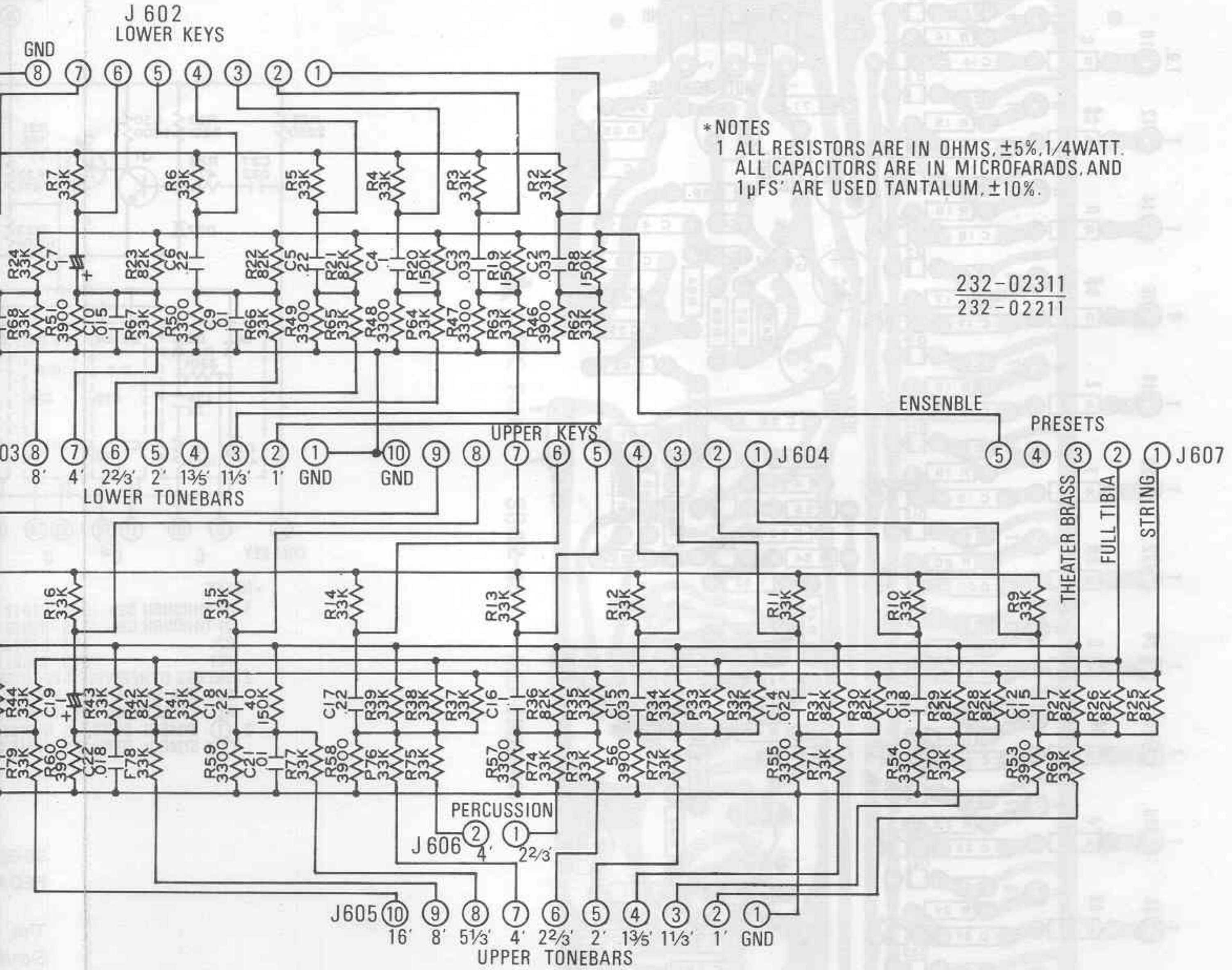


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TG-15(B) 232-02311
MIXTONE BOARD

This board provides the Tone Bars tones, and Presets Tones of each Manuals, upper and Lower. The circuits make up an RC ladder: The capacitors are used for D.C. bias cut, and the resistors are used for the signals added.

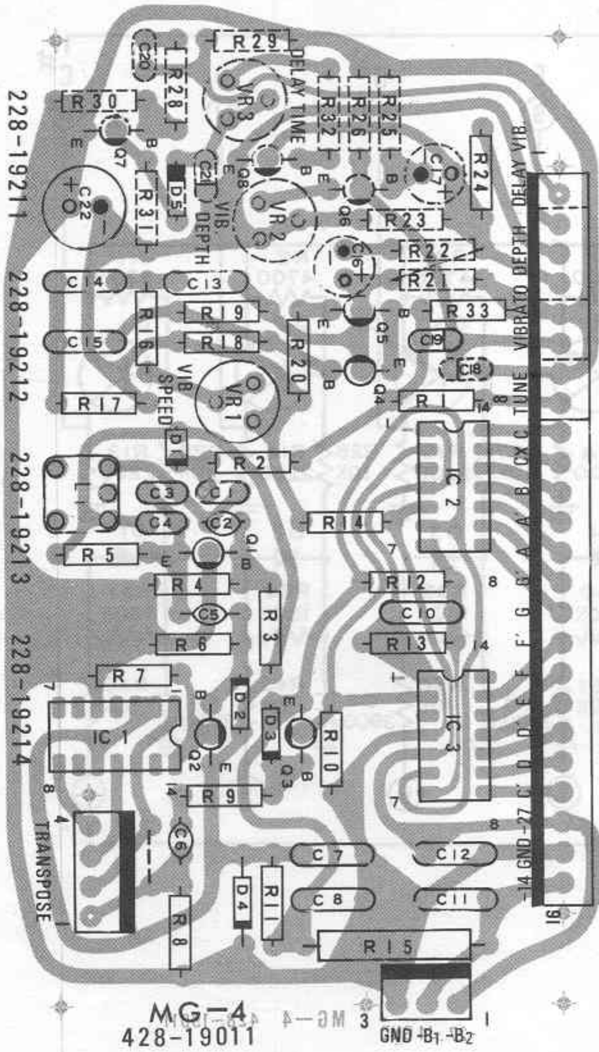
The signal inputs are to J602 and J604, through each manual; J602 is for Lower Manual, and J604 is for upper Manual.

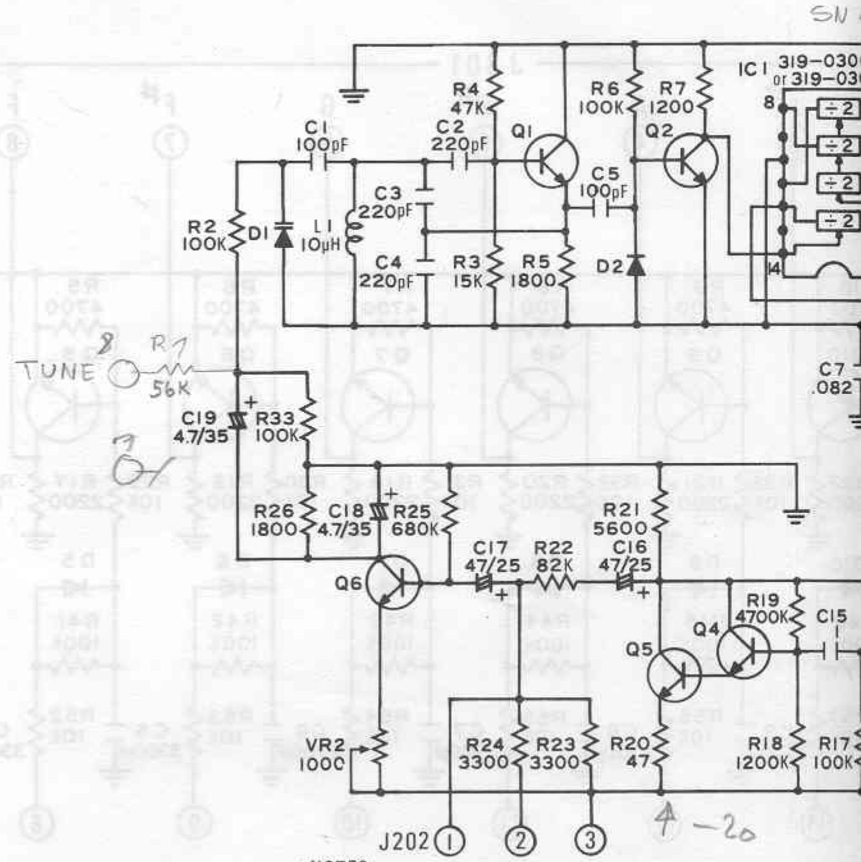
The output signals leave on J603, J605, J606, and J607: J603 is used for Lower Tone Bars, J605 is used for Upper Tone Bars, J606 is used for Percussion, and J607 is used for Presets Tones.

Pin 1 thru pin 3 are for Upper Manual Presets, the signal of pin 1 is for String, that of pin 2 is for Full Tibias, and that of pin 3 is for Theater Brass. The signal of pin 5 is for Ensemble of Lower Preset The signal of J606 pin 1 is for Third Harmonic, and that of J606 pin 2 is for Second Harmonic.

J601 is fed a negative D.C. voltage from DV-4(B) Divider Generator. This voltage is used for the bias, and the voltage is about −7 volts D.C.

FIGURE 3-8
TG-15(B) (232-02311)
MIXTONE BOARD
LAYOUT & THEORY





*NOTES
1 D1 306-05001 1S2206
D2,D3 306-01017 1S2473
D4 337-06014 RD-5.6EB
Q1 305-03014 2SC373
Q2THROUGHQ6 305-03040 2SC945Q
2 UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS.±5%.1/4WATT.
ALL CAPACITORS ARE IN MICROFARADS.
3 (1) SYMBOL DENOTES NUMBERS IN PLUG.

MDD GENERATOR-TWO PACKAGE SYSTEM VIBRATOABLE

LC Oscillator With Vibrato

Assembly MG-4(B) includes a vibrato oscillator, vibrato circuitry, and a high frequency LC oscillator used to drive the MDD generator.

The vibrato oscillator is a phase shift type, comprised of C13, C14, C15, R16, R17, R18, R19, R20, R21, VR1, Q4, and Q5. VR1 is used to adjust the oscillator's frequency. The vibrato signal is coupled through C16, R22, and C17 to the base of transistor Q6, where it is amplified,-(Its width being controlled by VR2.).

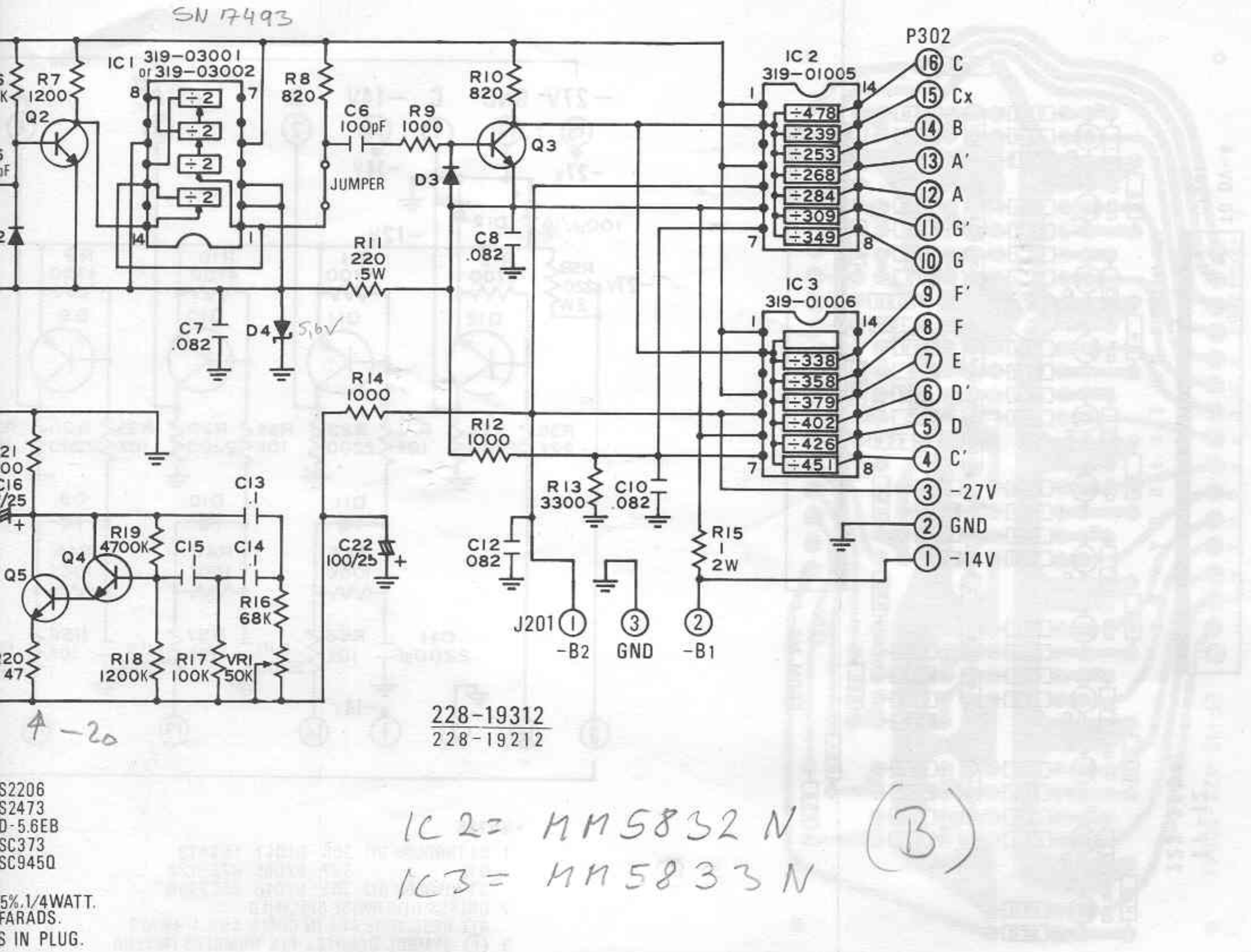
Vibrato may be turned off by connecting J202-1 to −20V (J202-3), and may be reduced for "Vibrato I or Vibrato II" by connecting R24 through J202-2 to −20V. To achieve a better sine wave the vibrato signals is filtered by C18 and is then coupled to the LC oscillator circuitry by C19.

The LC oscillator is comprised of L, D1, C1, C2, C3, C4, R3, R4, R5, and Q1, and is a Colpitts type. D3, a varicap diode, is used to vary the oscillator's frequency for vibrato and tuning control; As the voltage at the junction of R2, C1, an D1 becomes more negative, the capacitance of the varicap diode increases, and the oscillator frequency decreases. Since the cathode of the varicap is normally (with no vibrato) at ground potential and the anode is held at −5.6V by D4 and R1, the capacitance of the varicap remains constant, and stability of the oscillator is maintained. Capacitor C1 is used to isolate the D.C. bias on the varicap from the tank circuit. L1, with C3, C4, C1 and the varicap diode oscillator at 4.0048 MHz. R4 and R5 supply a bias voltage for Q1. The oscillator signal is coupled through C5 to buffer amplifier Q2 which drives I.C. 1.

MDD Gene

I.C. 1, a si
input signa
the MDD
driven by
this I.C. is
by C7.

I.C. 2 and
I.C. 2 gen
"Cx" and
I.C. 3 doe
buffer Q3
signal for



MDD Generator

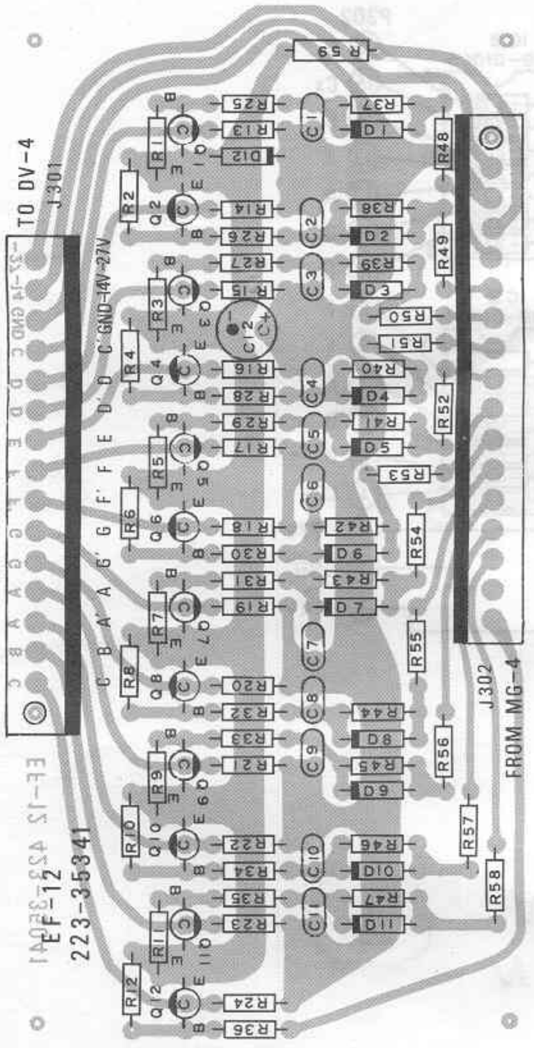
I.C. 1, a signal divider: It is used to insure a square input signal with a 50 per cent duty cycle to drive the MDD I.C. packages. This divider (I.C. 1) may be driven by the vibratoable oscillator. The −5V for this I.C. is generated by D4 and R11 and bypassed by C7.

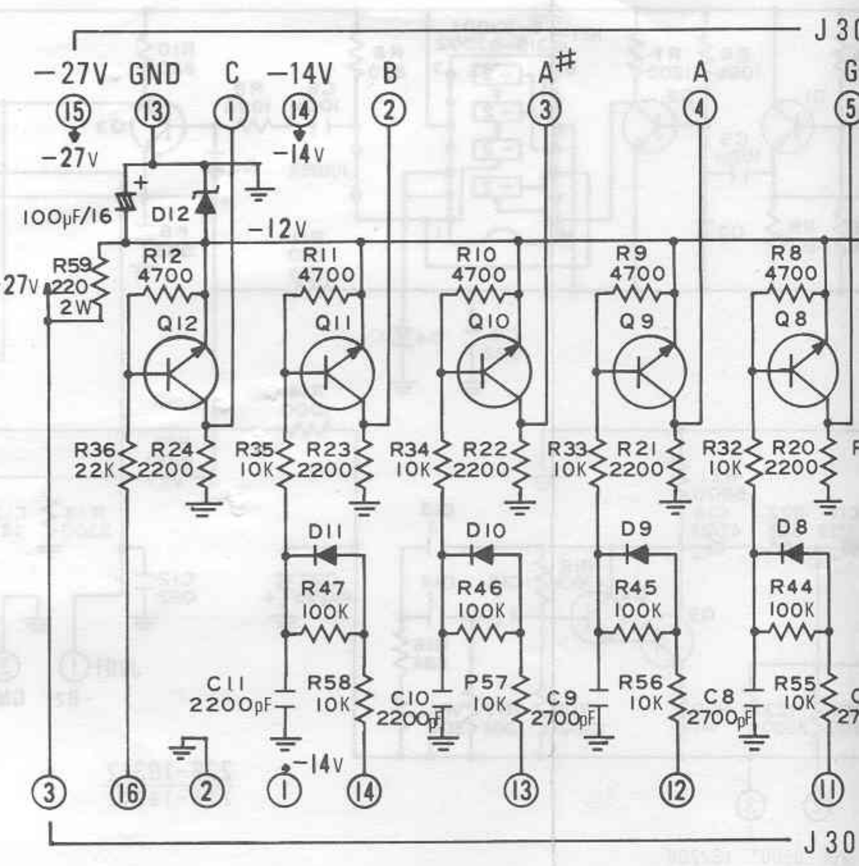
I.C. 2 and I.C. 3 are the two frequency generators: I.C. 2 generates frequencies of Note "G" through "Cx" and "C".

I.C. 3 does Note "C'" through "F'". I.C. 1 drives buffer Q3, supplying an 11V 2.00024 MHz clock signal for the MDD packages.

Three power supplies, −11V, −14V, and −27V, are required for the operation of the two MDD packages. The −14V and −27V are supplied from the organ power supply – PS-5(B)–. R12 and R13 form a voltage divider between ground and −14V to generate the −11V supply. Each of the three supplies is protected from static discharge by a capacitor (C8, 10, 11, 12).

FIGURE 3-11
MDD GENERATOR-TWO PACKAGE
(228-19312)
LAYOUT & THEORY



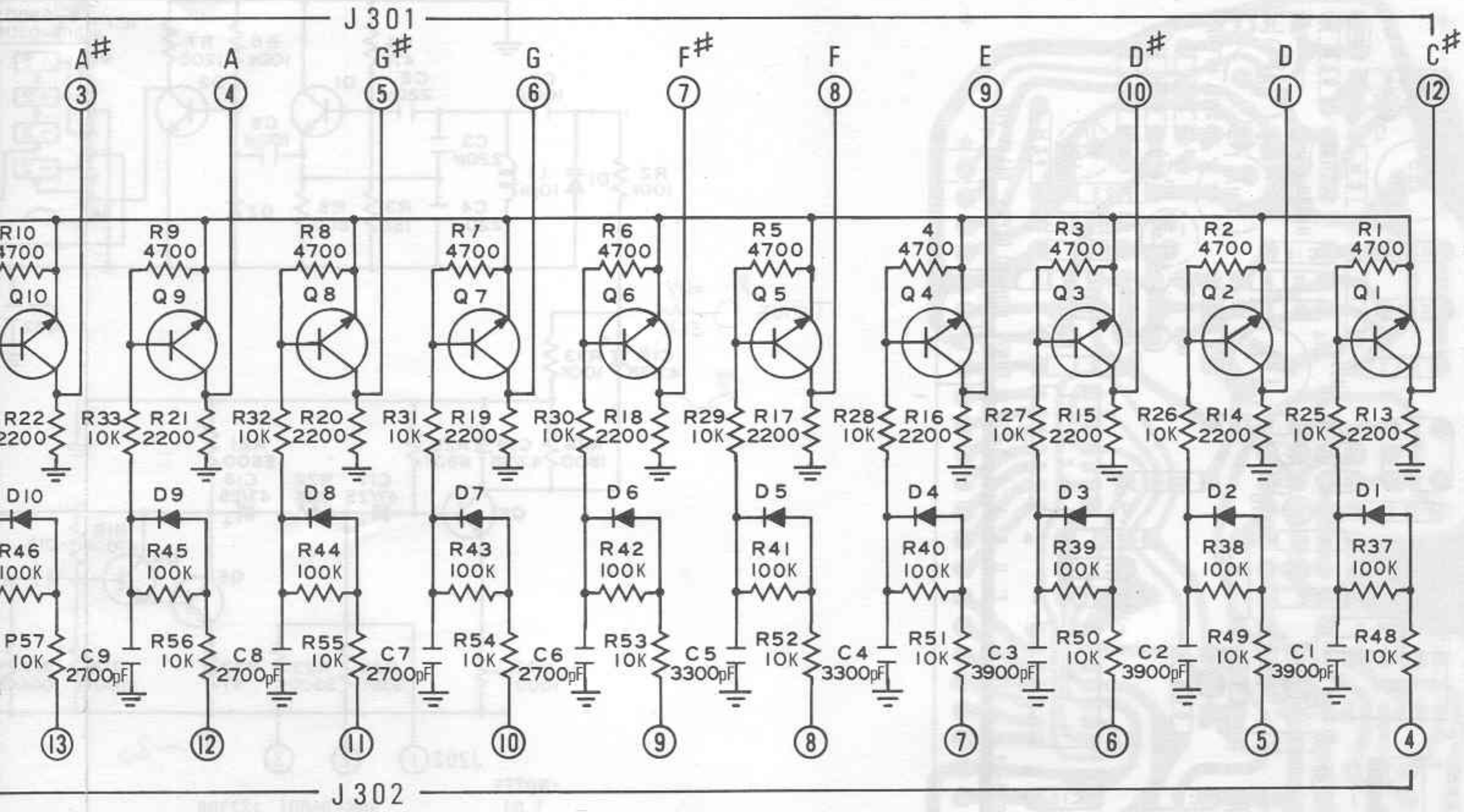


*NOTES
1 D1 THROUGH D11 306-01017 1S2473
D12 337-02005 02Z-12A
Q1 THROUGH Q12 305-03040 2SC945Q
2 UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS. ±5%. 1/4WATT.
3 ① SYMBOL DENOTES PIN NUMBERS IN PLUG.

EF-12 223-3
MDD BUFF

This board
Board, on
approximate

There are 12
are Q1 thro
are connect
Q12 is cor
connector
Generator
pin 16, but
forms are n
duty cycle, l
These input



S2473
2Z-12A
SC9450

5%, 1/4WATT.
MBERS IN PLUG.

223-35341
223-35241

EF-12 223-35341 MDD BUFFER BOARD

This board provides the clocks to drive the DV-4 Board, on which wave forms are squared and approximately 50% duty cycle.

There are 12 transistors located on this board, which are Q1 through Q12. The inputs of these transistors are connected through RC filters, but the input of Q12 is connected through resistor only, to the connector J302. These inputs from the MDD Generator Board enter on J302 pin 4 through pin 16, but pin 15 is not used. These input wave forms are not 50% duty cycle, those are 30%-70% duty cycle, but "C" Note, pin 16, is 50% duty cycle. These inputs are fed to RC time delay circuits.

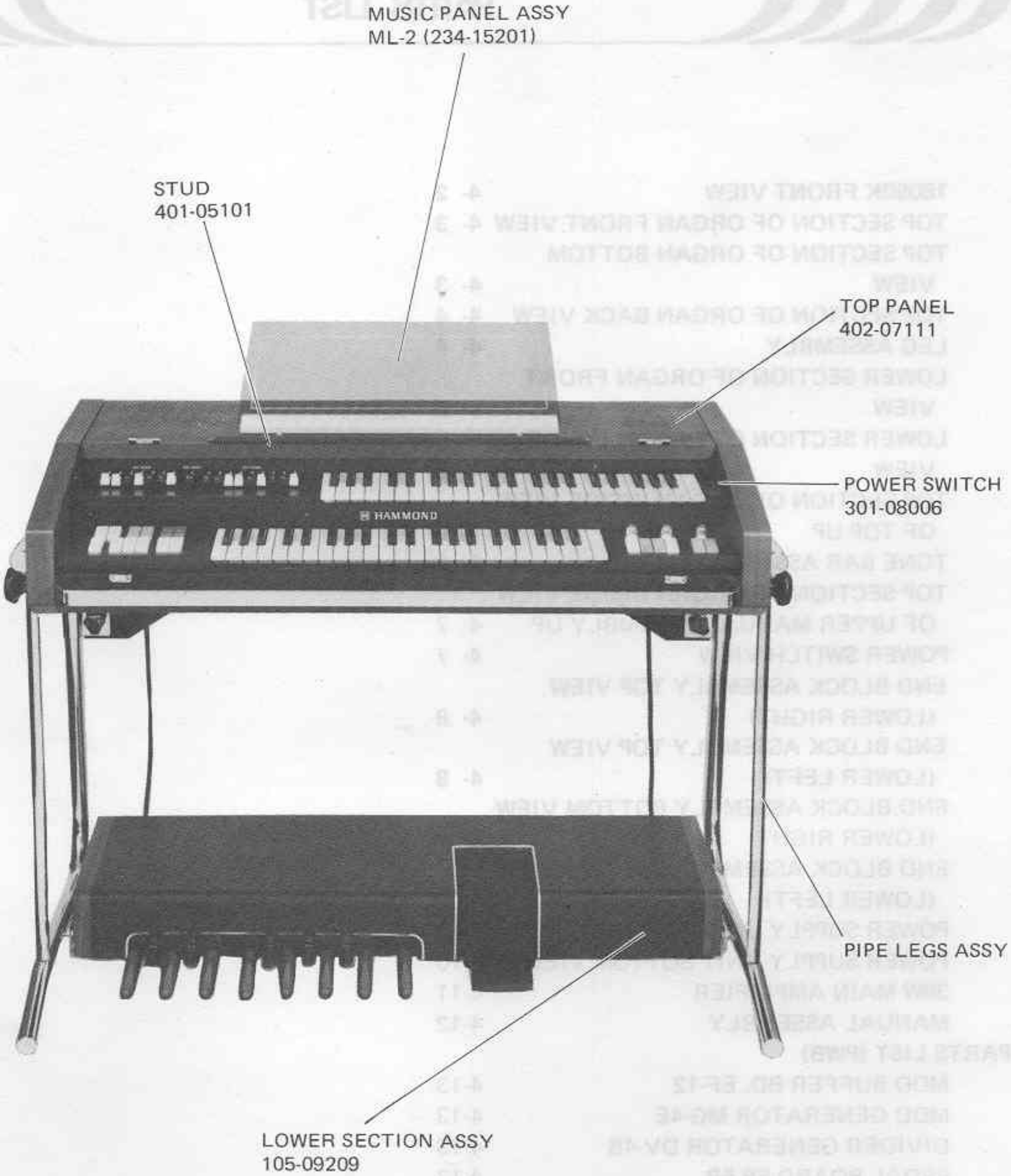
These time delay circuits provide the charge up without time delay, and the discharge down with time delay, and these signals are fed to buffer transistors, which operate inverters. These output wave forms are approximately 50% duty cycle. The output of "C" Note is inverted only.

These outputs come on J301 pin 1 through pin 12, and these signal voltages are approximately 12 volts negative going in amplitude.

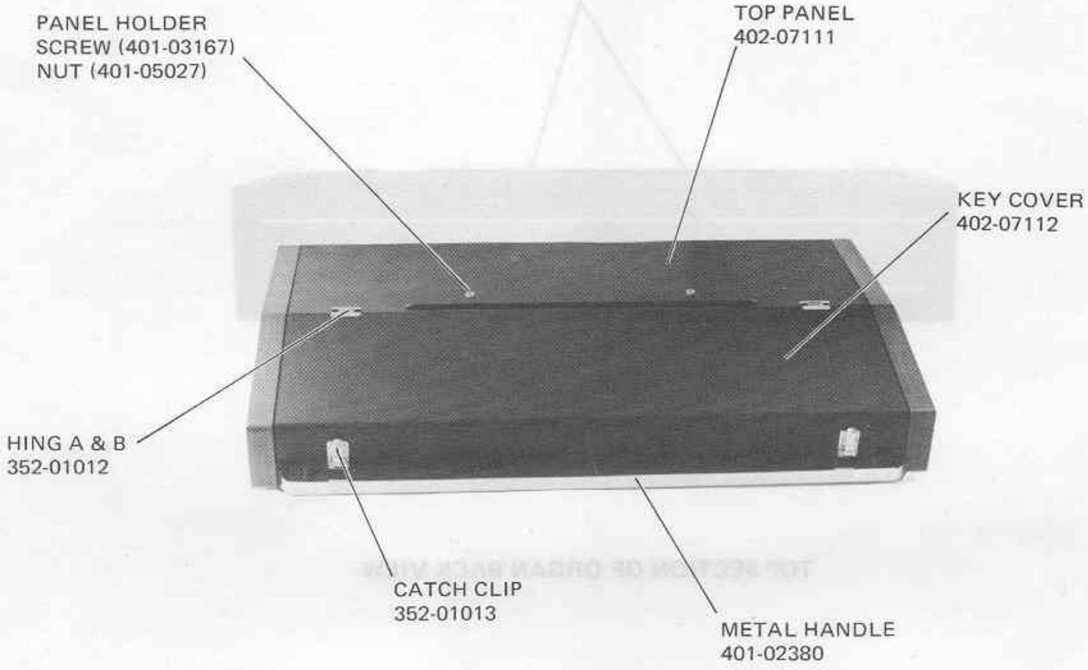
The connector J302 is connected to the connector P302 of MG-4 MDD Generator Board, and the connector J301 is connected to T1 through T12, T37, T38, and T39 of DV-4 Divider Generator Board.

FIGURE 3-12
MDD BUFFER BOARD
(223-35341)
LAYOUT & THEORY

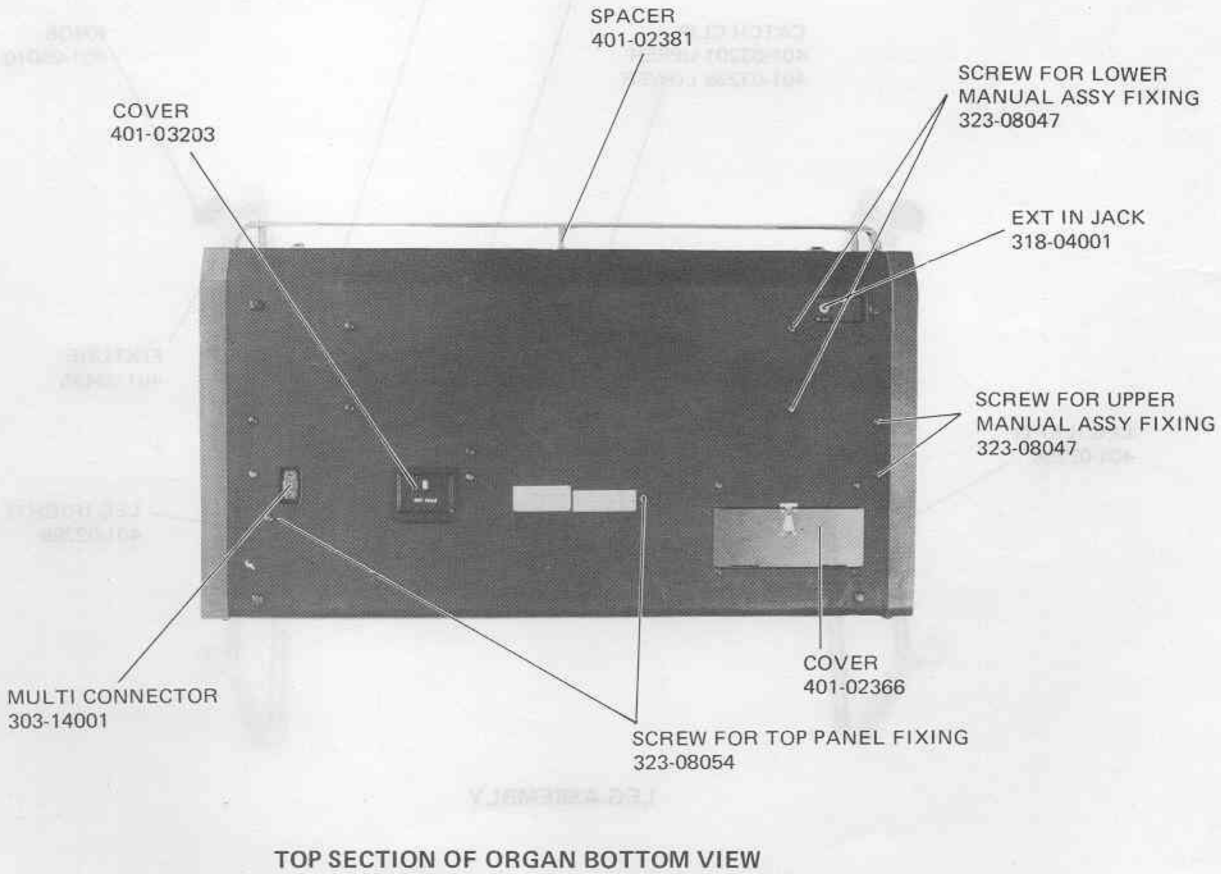
SECTION IV PARTS LIST



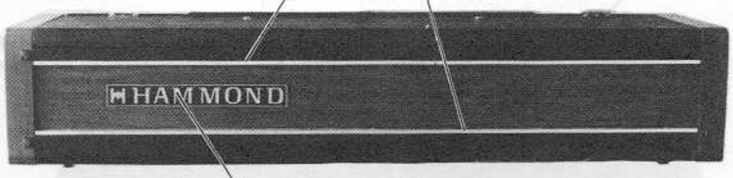
18050K FRONT VIEW



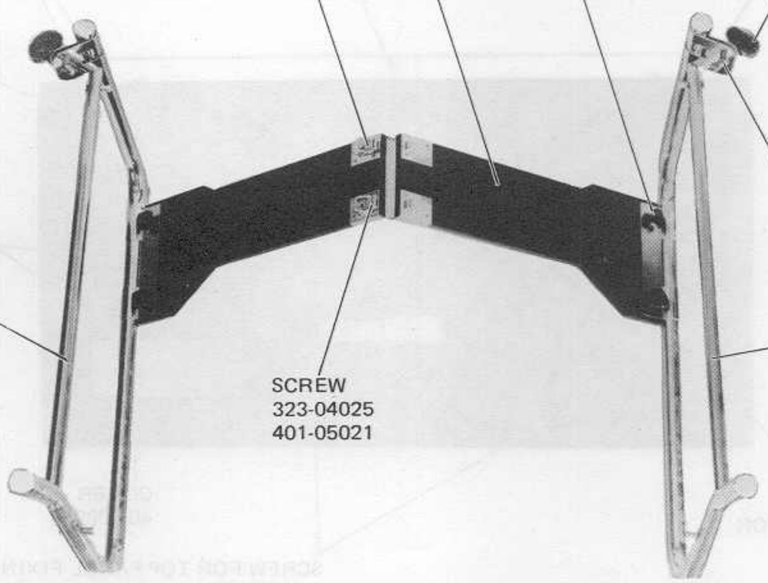
TOP SECTION OF ORGAN FRONT VIEW



TOP SECTION OF ORGAN BOTTOM VIEW

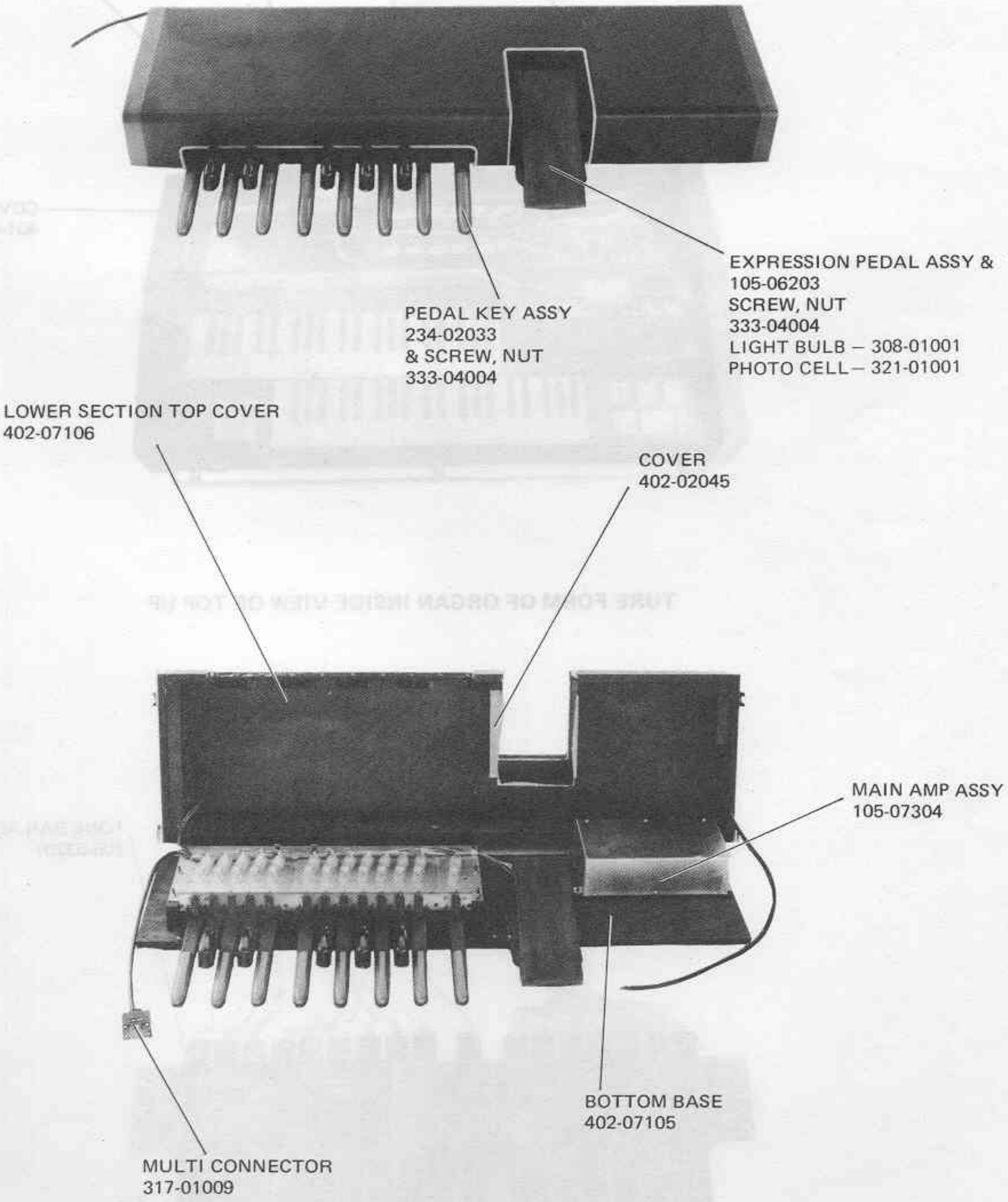


TOP SECTION OF ORGAN BACK VIEW

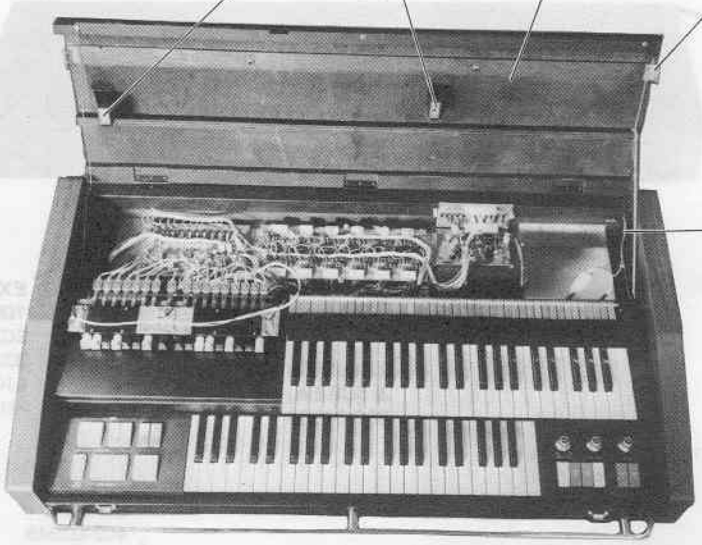


LEG ASSEMBLY

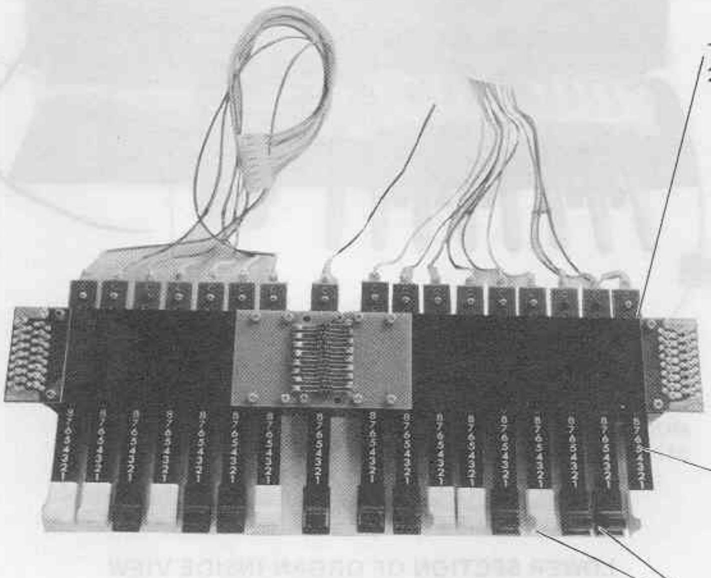
LOWER SECTION OF ORGAN FRONT VIEW



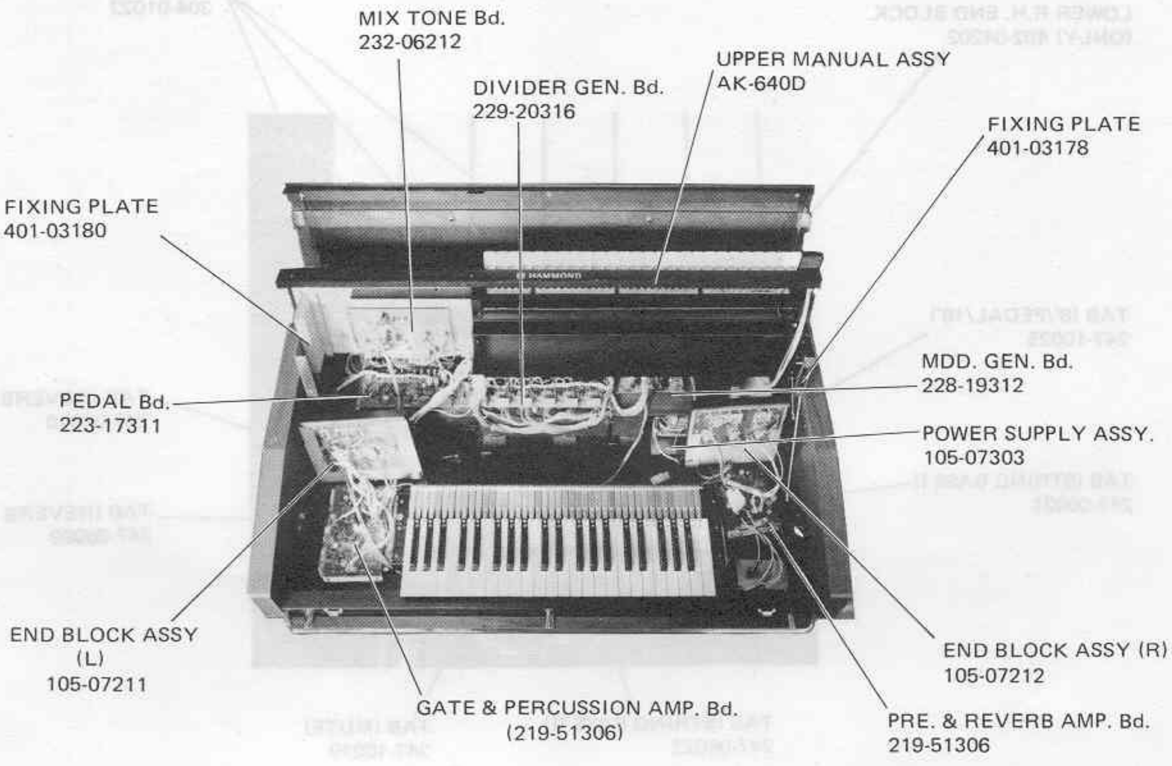
LOWER SECTION OF ORGAN INSIDE VIEW



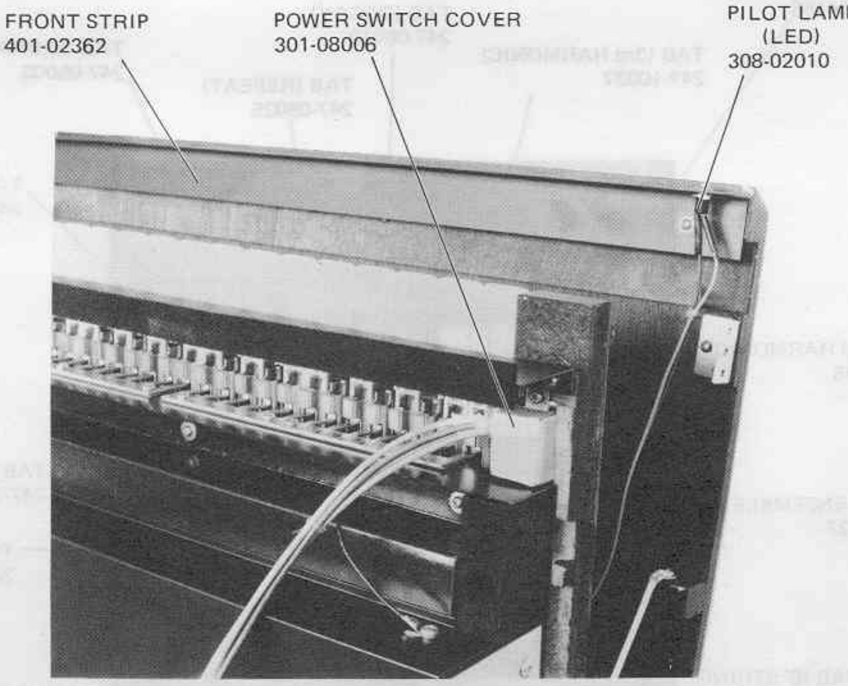
TURE FORM OF ORGAN INSIDE VIEW OF TOP UP



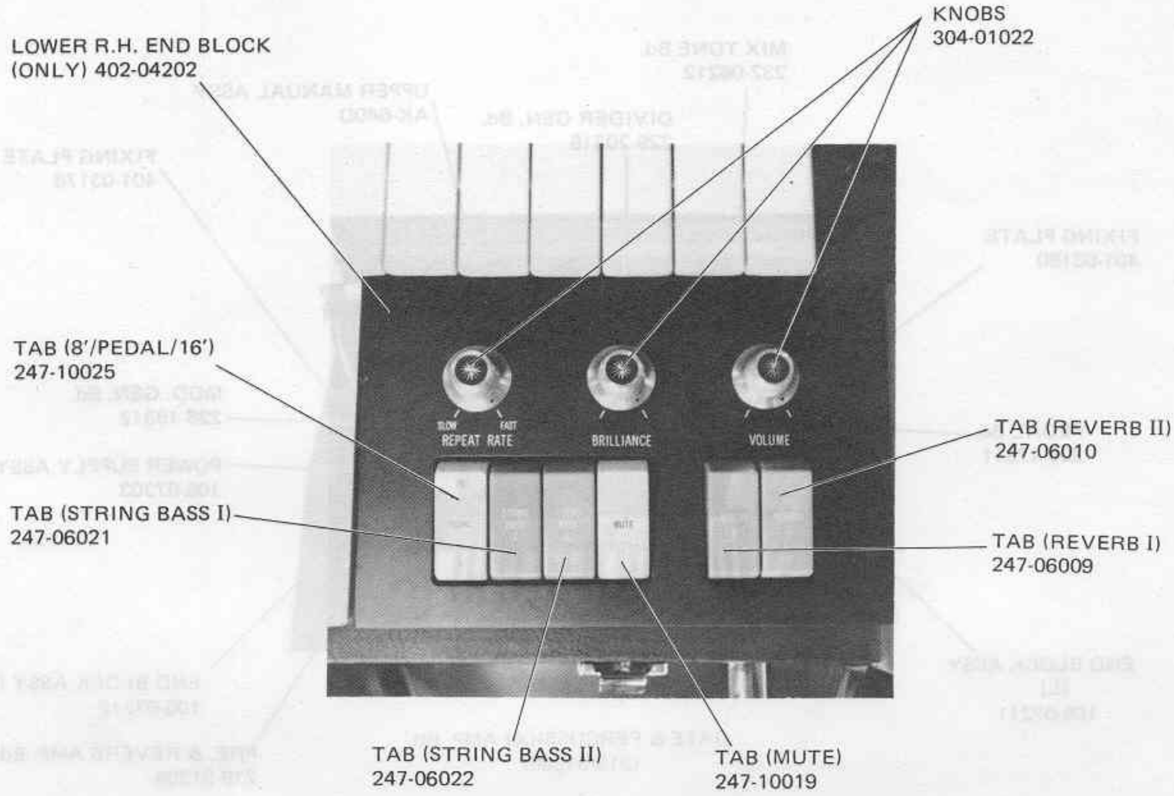
TONE BAR ASSEMBLY



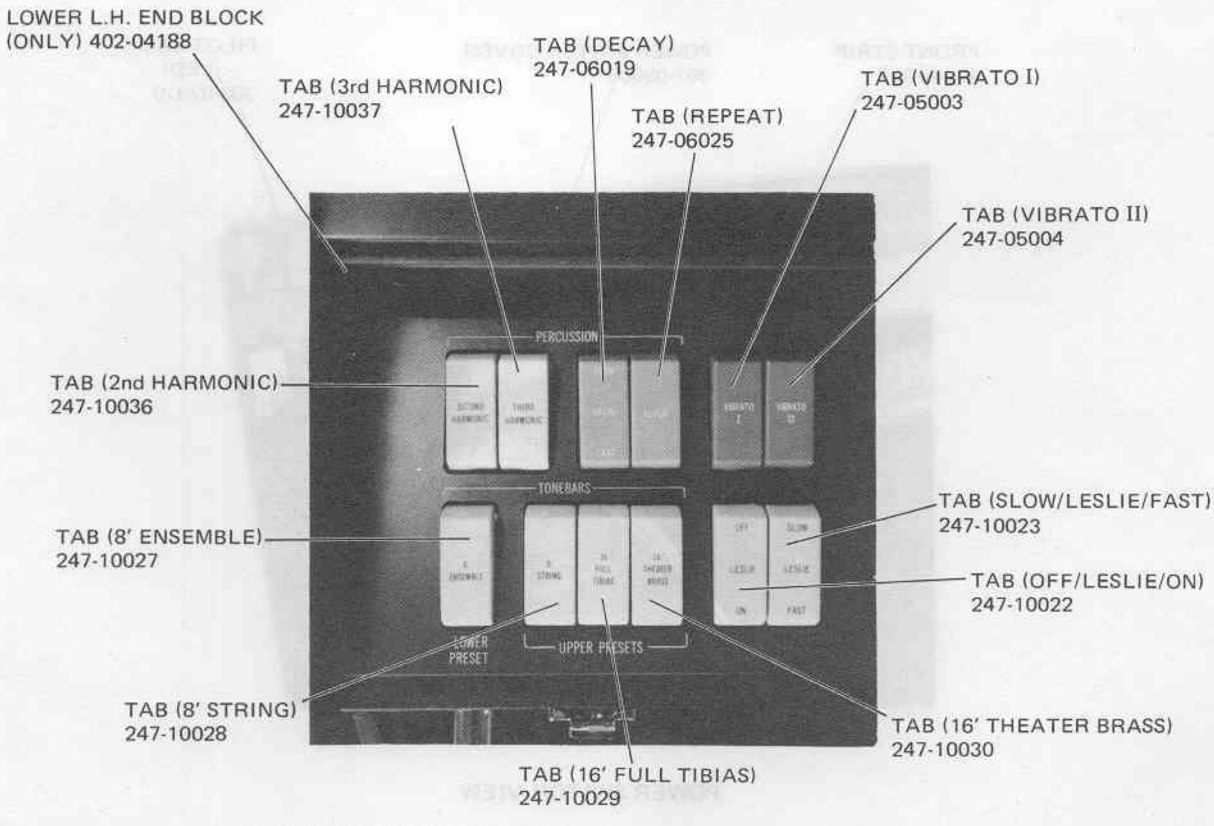
INSIDE VIEW OF UPPER MANUAL ASSEMBLY UP



POWER SWITCH VIEW

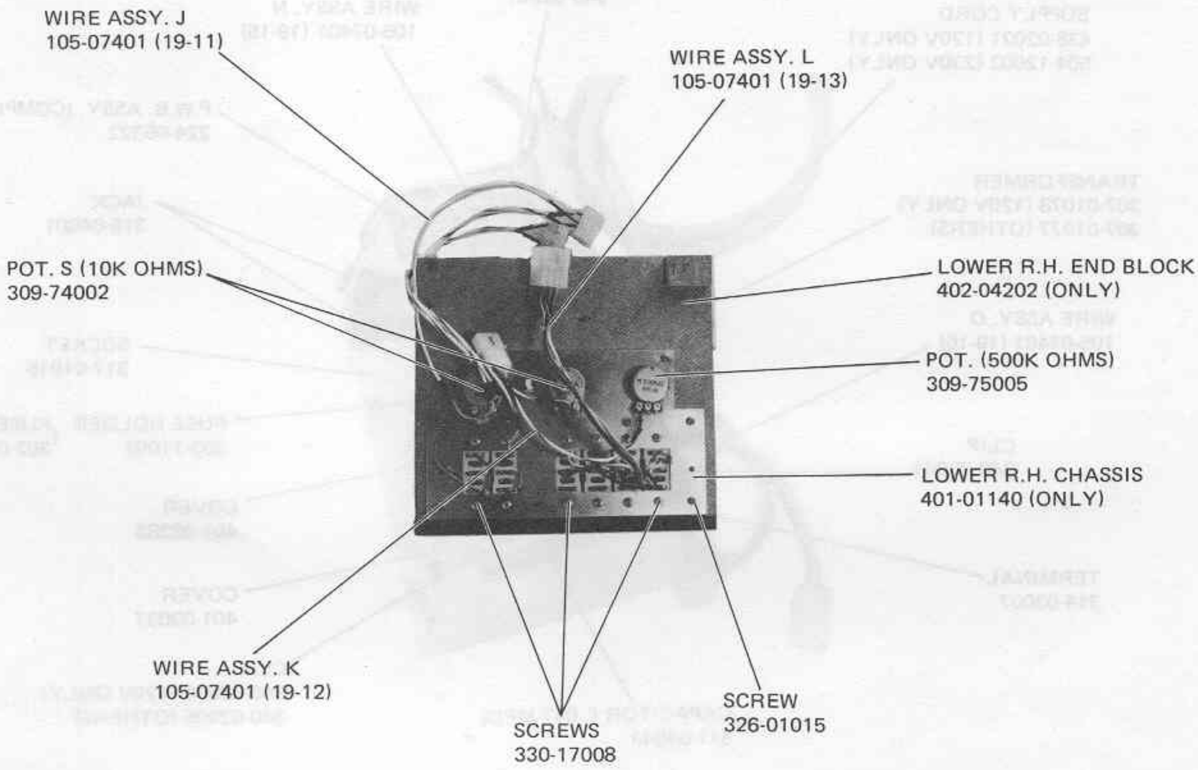


LOWER RIGHT-HAND END BLOCK ASSEMBLY – TOP VIEW (COMPLETE)

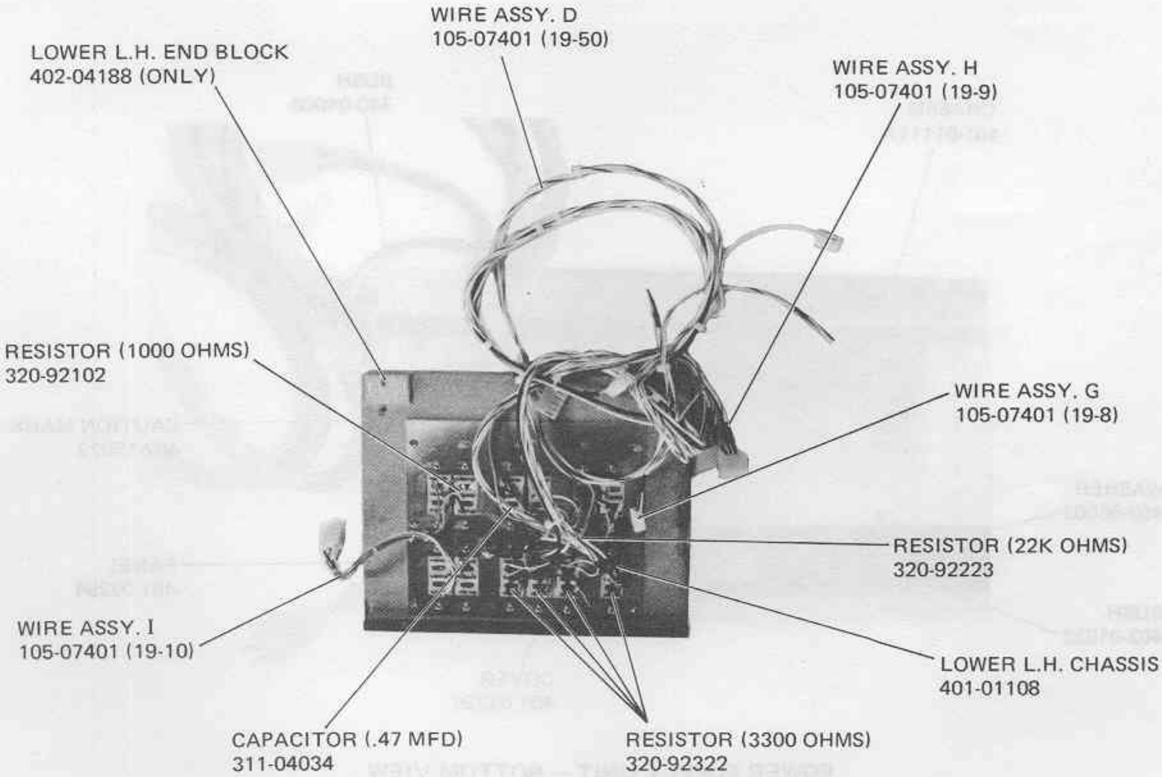


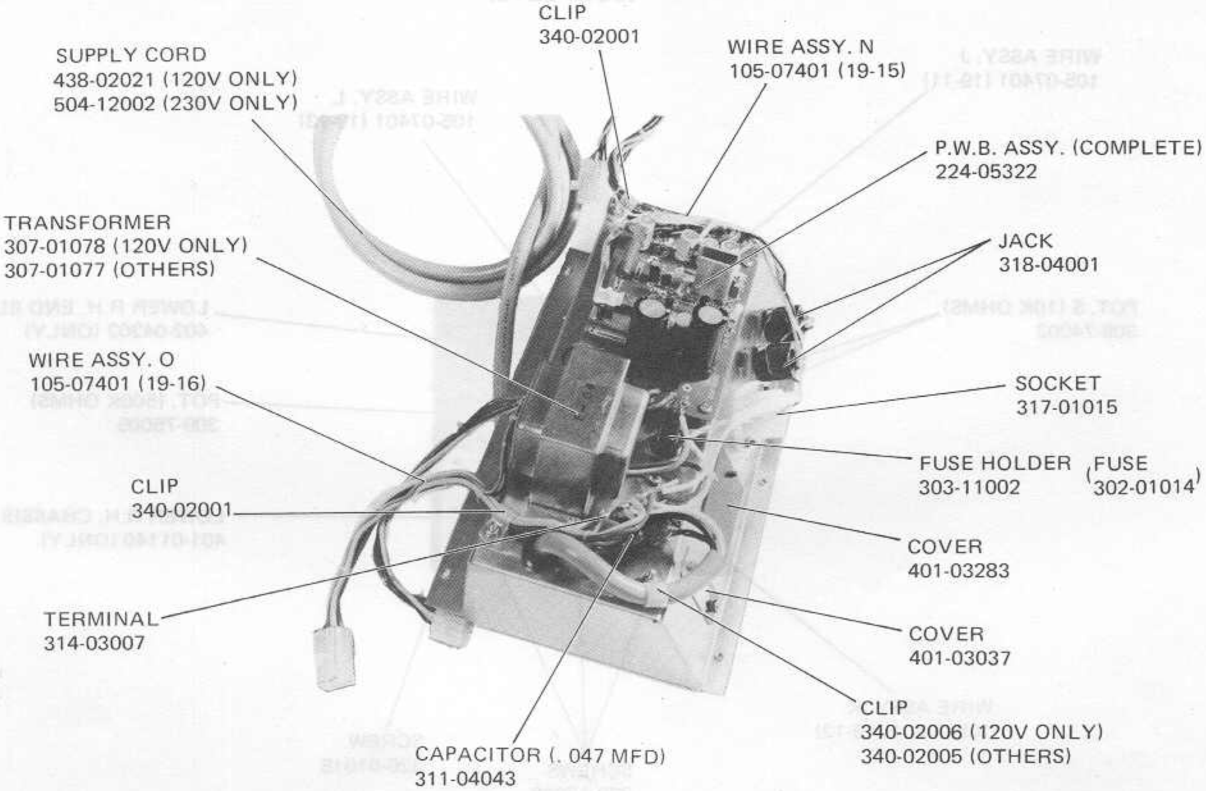
LOWER LEFT-HAND END BLOCK ASSEMBLY – TOP VIEW (COMPLETE)

LOWER RIGHT-HAND END BLOCK ASSEMBLY – BOTTOM VIEW (COMPLETE)

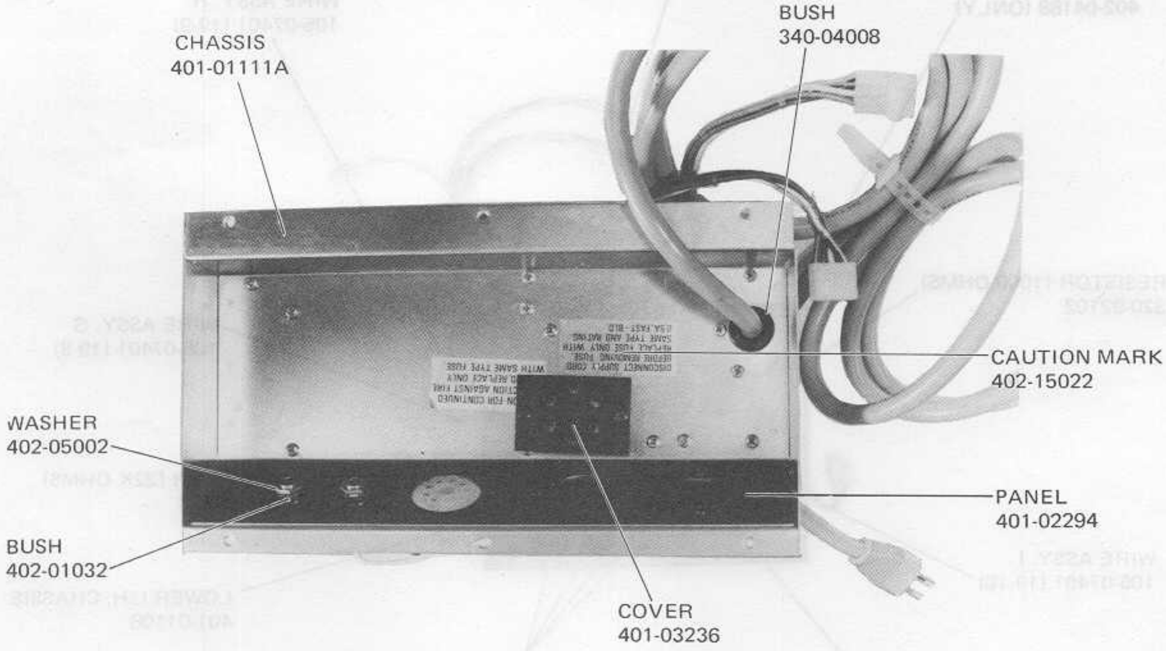


LOWER LEFT-HAND END BLOCK ASSEMBLY – BOTTOM VIEW (COMPLETE)

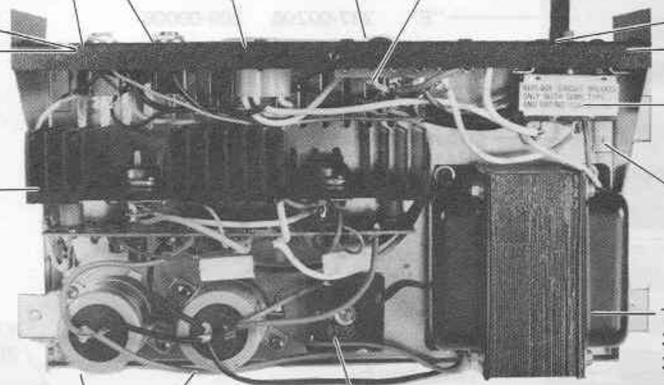




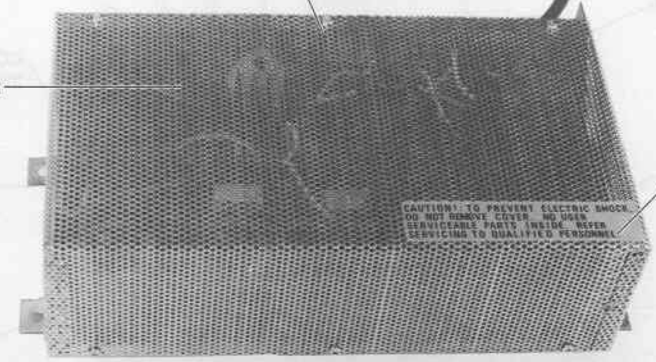
POWER SUPPLY UNIT – TOP VIEW
105-07303



POWER SUPPLY UNIT – BOTTOM VIEW



30 WATT MAIN AMPLIFIER – (COMPLETE)
105-07304



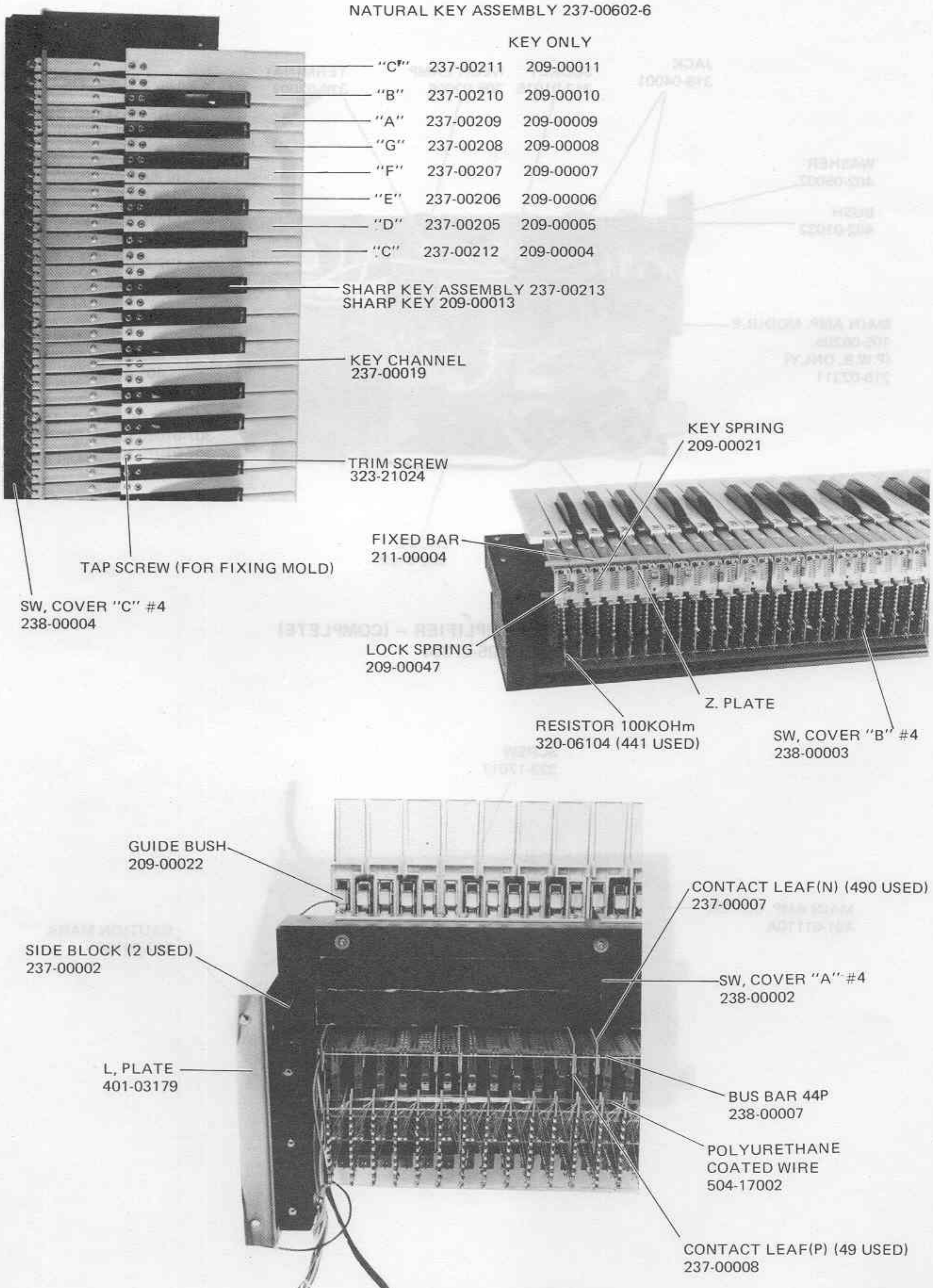


FIGURE 2. MANUAL ASSEMBLY
UPPER MANUAL (AK-640D)
LOWER MANUAL (AK-648D)

MDD Buffer Board -EF-12- 223-35341

Diode, Zener 12V		D-12	337-02005
Diode		D-1 Through 11	306-01017

MDD GENERATOR Board -MG-4(B)- 228-19312

Diode		D-2, 3,	306-01017
Diode, Varicap		D-1	306-05001
Diode, Zener 5.6V		D-4	337-06014
Coil	10 μH	L-1	322-01028
Transistor, NPN		Q-1	305-03014
Transistor, NPN		Q-2, 3, 4, 5, 6,	305-03040
Integrated Circuit		IC-1	319-03001
Integrated Circuit		IC-2	319-01005
Integrated Circuit		IC-3	319-01006
IC Socket 14P			303-13005
Socket Assembly		P-302	317-03068
Pot Trim	1000 Ohms	VR-2	336-01003
Pot Trim	50K	VR-1	336-01009

Divider Generator Board -DV-4(B)- 229-20316

Diode		D-1 Through 72	306-01017
Integrated Circuit		IC-1 Through 12	319-01007
IC Socket 14P			303-13005

Pedal Board -SB-5(B)- 223-17311

Diode		D-1 Through 29	306-01017
Transistor, NPN		Q-1 Through 6	305-03040
Transistor, NPN		Q-7	305-03023
Integrated Circuit		IC-1	319-23001

Mix. Tone Board -TG-15(B)- 232-02311

Gate & Percussion Amp. Board -PA-33(B)- 219-04312

Diode		D-1, 2, 3, 4,	306-01017
Diode, Zener 12V		D-5	337-02007
Transistor, PNP		Q-1, 2, 3	305-01006
Transistor, NPN		Q-4, 5, 6, 7, 8, 9,	305-03023
Transistor, NPN		Q-13, 14, 15	305-03040
Transistor, FET		Q-10, 11, 12	305-05005
Wafer Assembly		J-705	317-03053
Wafer Assembly		J703(704)	317-03054
Wafer Assembly		J701, 702	317-03055
Wafer Assembly		J708(707)	317-03060

Power Supply Board -PS-5(B)- 224-05311

Diode		D-1	306-01023
Diode		D-2	306-01024
Diode, Zener 6V		D-3	337-02001
Transistor, PNP		Q-3, 4	305-01008
Transistor, PNP		Q-5, 6	305-01013
Transistor, NPN		Q-2	305-03040
Transistor, NPN		Q-1	305-03027
Heat Sink		(Q-1)	341-06003
Heat Sink		(Q-6)	341-06004
Screw			323-17019
Nut			323-04003
Fiber Tube			505-03023

Pre. & Reverb Amp. Board -PA-56- 219-51306

Transistor, PNP		Q-1, 7, 8	305-01006
Transistor, NPN		Q-2 Through 6	305-03023
Transistor, PNP		Q-10	305-01014
Transistor, NPN		Q-9	305-03041
Integrated Circuit		IC-1	319-23001
Pot Trim	10K	VR-3	336-01006
Pot Trim	100K	VR-2	336-01010
Pot Trim	50K	VR-1	336-01009

Main Amplifier Board -PW-27(B)- 218-02311

Diode		D-3, 4	306-01017
Diode, Zener 15V		D-1, 2	337-06013
Transistor, PNP		Q-3	305-02010
Transistor, NPN		Q-1	305-03040
Transistor, NPN		Q-2	305-04012
Integrated Circuit		IC-1	319-23001
Pot Trim	5K	VR-1	336-01005

NEW X-5 BASS SYSTEM

PEDALS & BASS TO LOWER MANUAL

INTRODUCTION

The new X-5 Bass System supplies bass tones for 13 pedals at both 16' and 8' pitches, as well as bass tones for twenty lower manual keys. Figure 1 shows the relative ranges of bass tones employed by the lower manual and pedals. In manual bass the system operates in a low select manner because of the action of 3 priority-encoder ICs. In pedal bass mode the system operates high select because of the wiring of the pedal assembly.

The heart of the X-5 Bass System is the Bass Generator Board (223-35386). This board contains 10 basic sections. These sections are:

1) A diode ladder matrix
2) A priority encoder stage
3) An inverter NOR gate stage
4) A latch stage
5) A channel data selector stage (Multiplexer)
6) A divider stage
7) Octave select gates
8) Envelope gates
9) A Mute filter
10) An amplifier stage

These stages interact to provide all the features that are associated with bass on the X-5. Figure 2 in the back of this booklet demonstrates how these basic stages fit together in a functional block diagram.

Notice in Figure 2 that the keying inputs from the pedals or lower manual are applied to J503, J504, and J505 and the diode matrix. The selected keying inputs are logic 1 (ground) levels which are received by the matrix and are sent to the appropriate data (D1-D7) inputs of the priority encoder stage (ICs 1, 2 and 3).

The priority encoder ICs encode the highest priority input (D7-D0) to a 3 bit binary code. This code is released at the Q2, Q1, and Q0 outputs. The encoders also release inhibit/enable information at their Gs outputs. This inhibit/enable information is used to disable or enable the data selector ICs later on in the keying process.

Both the note select code and the inhibit/enable code are sent to the inverter stages of IC7 and transistors Q1-Q2 respectively. The NOR gates within IC 7 invert the note select data, and transistors Q1 and Q2 invert the inhibit/enable information.

Following inversion, the two codes travel to the latch stage. Latching is accomplished by ICs 8, 9, 10, and 11 which are quad NAND gates wired as flip-flops. The latches receive the data from the inverters, re-invert the information, memorize the information, and then apply the information to the note select (A, B, C) and disable (D) inputs of the data selector ICs 4, 5 and 6.

The combination of note select and inhibit data at ICs 4, 5, and 6, allows a specific bass frequency (from J501, J502, or J503) to pass through the appropriate data selector IC and reach the Z output buss. The selected signal enters a buffer stage and flows to the divider stage of IC15.

Figure 2 demonstrates that IC15, a dual D flip-flop generates the low bass, and medium bass frequencies. The output signal from the data selector ICs clocks IC15 and also feeds IC12 as the high bass signal. The high bass, medium bass, and low bass signals then enter IC12, the bass select gates.

The combinations of inputs at the bass select gates from the key down data buss (S), the bass elect data bass (R), and the 16'/8' stop determine which combination of bass frequencies pass through the bass select gates of IC12 and enter the envelope gates of IC14.

During times of manual or pedal down, the key down data buss applies an input to the D section of IC14. The NAND gate activates transistor Q4, and Q4, in turn, sends a gating pulse to the 3 envelope NAND gates of IC14 A, B, and C. The result of this operation is the gating of the appropriate bass tones through the envelope gates to the RC mute filter. If String Bass is selected, the envelope generator continues to function after the key or pedal is released and a sustain effect occurs.

At the RC mute filter transistors Q8 and Q9 normally permit maximum bass signal to reach amplifier Q10. When the mute tab is activated, transistors Q9 and Q10 conduct and shunt a portion of the bass signal away from Q10. The result of the mute operation is a significant drop in volume of the bass tones.

The output signal of the mute filter feeds amplifier Q10, travels through the bass level adjust potentiometer, and leaves the Bass Generator Board at J507 pin 1. After leaving the Bass Generator Board, the bass signal travels to the organ preamp where it mixes with signals from other systems of the organ.

GENERATION OF BASS TONES (EXAMPLES)

As stated previously, the Bass Generator Board contains 10 basic sections. These sections interact to produce all base tones required by the organ. The operation of the Board, however, is not consistent over the entire pedal and manual frequency ranges. The board can operate in five different modes, and the selected pedal or lower manual keys in the 16' or 8' settings determine the appropriate mode. The following list defines the conditions which set the Bass Generator Board for the various modes of operation:

Mode #1: The pressing of a pedal 1-5 (low C through E) when the bass stop is set for 16'.

Mode #2: The pressing of a pedal 6-13 (F through high C) when the bass stop is set for 16'.

Mode #3: The pressing of a pedal 1-5 when the bass stop is set for 8'.

Mode #4: The pressing of a pedal 6-13 when the bass stop is set for 8'.

Mode #5: The pressing of a lower manual key 1-20 when the

bass to lower coupler is "ON".

In each of these modes the "String Bass" and the "Mute" features can be used.

The following descriptions are step by step circuit analyses of the Bass Generator Board for the 5 different modes of operation. Refer to Figures 3, 4, and 5.

EXAMPLE #1 - MODE #1

Assuming that pedal #2 (C#) is depressed and the bass tab is set for 16', the following operation occurs:

The activation pedal #2 (C#),transfers a logic 1 (ground potential) to J503 pin 2 of the Bass Generator Board. This logic 1 (grd) passes through the matrix diode D6 and reaches the D7 input of priority encoder IC2 at pin 4. The logic 1 (grd) at J503 pin 2 also changes the bass select data buss (R) and the keydown data buss (S) from a logic 0 (—14V) to logic 1 (grd).

With a logic 1 (grd) applied to the D7 input of IC2, the E0 output (pin 15) of IC2 falls from a logic 1 (grd) to a logic 0 (—14V). This transition disables IC1. Also, at this time, the Gs output of IC2 rises from a logic 0 (—14V) to a logic 1 (grd). The Gs output is supplied to the input of transistor Q1. Finally with a logic 1 (grd) applied to the D7 input, IC2 releases the note select code of (1, 1, 1) from its Q2, Q1 and Q0 outputs. These outputs exist on pins 6, 7, and 9 respectively.

After the Gs output of IC2 is inverted to a logic 0 (—14V) by transistor Q1, the signal works with the inverted Gs output of IC3 (logic 1 at transistor Q2's output) to form the 2-bit inhibit/enable code.

The 2-bit code activates two latches with ICs 9 and 10. The logic 0 (—14V) at the output of transistor Q1 combines with the logic 1 (grd) of the keydown data buss (S) at NAND gate IC10D; the logic 0 (—14V) also travels to the input pin 6 of IC9A - one half of a latch consisting of IC9A and IC9B. The logic 1 (grd) and logic 0 (—14V) inputs to IC10D force a logic 1 output at pin 11 of IC10D.

Now, with a logic 0 (—14V) applied to pin 1 of IC9A and a logic 1 applied to pin 6 of IC9B, the latch forces a logic 0 (—14V) to pin 4 of IC9B. This logic 0 (—14V) travels to the disable input (D1 pin 15) of data selector IC5. With logic 0 (—14V) maintained at the D1 input of the IC5, the chip becomes enabled and, therefore, available for operation. The logic 0 (—14V) at IC9B pin 4 is also applied to IC11A pin 2. At IC11A, the logic 0 (—14V) combines with the output of IC10B pin 4. To determine the output level of IC10B pin 4, we must follow the Gs output of IC3.

Because priority encoder IC2 receives no logic 1 (grd) D inputs with the C# pedal depressed, its Gs output must maintain a logic 0 (—14V) level. Transistor Q2 inverts this logic 0 (—14V) into a logic 1 (grd) and applies that level to pin 9 of IC10C and pin 6 of IC10B.

The logic 1 (grd) output of Q2 then combines with the logic 1 (grd) of the keydown buss at IC10C. As a result, the NAND gate output pin 10 falls to a logic 0 (—14V) which is transferred to pin 1 of IC10A. Now, because the input pin 6 of IC10B is held to logic 1 (grd), and the input pin 1 of IC10A is held to logic 0 (—14V), the latch forces a logic 1 (grd) at IC10A pin 3.

The logic 1 (grd) at IC10A pin 3 travels to the disable (D2) input of data selector IC4 pin 15. This disables IC4. Also, the logic 1 (grd) at pin 3 of IC10A combines with logic 0 (—14V) from pin 4 of IC9A at IC11A. The logic 1 (grd) and logic 0 (—14V) inputs of IC11A force a logic 1 (grd) at pin 3 of IC11A, and this level reaches the disable (D0) input of IC6, disabling IC6.

Thus far, we have examined how the Gs outputs of ICs 2 and 3 have formed a 2-bit inhibit/enable code that has enabled IC5 and has inhibited IC4 and IC6 when the pedal is depressed. In order for IC4 to release the appropriate bass frequency, the chip must receive a 3-bit note select code at its A, B, and C inputs. Therefore, we must return to the Q2, Q1 and Q0 outputs of IC2.

Earlier, we stated that with the D7 input of IC2 held to a logic 1 (grd), the chip's Q2, Q1 and Q0 outputs were al logic 1 (grd) levels. These levels are sent directly to the inverting NOR gates of IC7. IC7's A, B, and C sections invert the Q2, Q1 and Q0 outputs of IC2 to logic 0 (—14V) levels. These levels are then applied to the latches of ICs 8 and 9, and to NAND gate IC11.

The inverted Q2 output leaves pin 6 of IC7A as a logic 0 (—14V). This level is transferred to pin 13 of IC11D as well as to pin 13 at IC9D. At IC11D the logic 1 (grd) of the keydown data buss combines with the logic 0 (—14V) to force the NAND gate to release a logic 1 (grd) to pin 8 of IC9C. Now, with IC9C and IC9D receiving logic 1 (grd) and logic 0 (—14V) inputs respectively, the pin 11 output of latch IC9C/9D goes to a hi logic 1 (grd) level. This level is applied to the "C" data line of the data selectors ICs 4, 5, and 6.

The inverted Q1 output leaves pin 9 of IC7B as a logic 0 (—14V). Also from pin 9 the low level travels to pin 5 of IC11B as well as to pin 1 of IC8A. At IC11B the logic 0 (—14V) from IC7 pin 9 becomes "NANDED" with the logic 1 (grd) of the keydown data buss. The NAND process yields a logic 1 (grd) at pin 6 of IC8B. The combination of logic 1 (grd) at pin 6 of IC8B and the logic 0 at pin 1 of IC8A makes flip-flop IC8B/8A provide a logic 1 (grd) to the "B" data line of data selectors.

Finally, the logic 0 (—14V) Q0 out of IC7C pin 10 travels to pin 9 of IC11C and to pin 13 of IC8D. IC11C NANDS the logic 1 (grd) of the keydown buss and the logic 0 (—14V) output of IC7C. This holds pin 8 of IC8C to logic 1 (grd). Consequently, the flip-flop IC8C/8A places a logic 1 (grd) level on the "A" data line of the data selectors.

At this time data selectors ICs 4, 5, and 6 receive logic 1's (grd) at their A, B, and C inputs. These inputs will be maintained by the flip-flops even after pedal #2 is released (to allow the sustain in String Bass). Only IC5 responds to the code at its A, B, and C inputs because IC4 and 6 are disabled by the logic 1 (grd) levels at their D inputs. The result of this process is the transferr the C# bass signal from the X7 data input of IC5 to the Z signal output of

l[illegible]. The signal is available on the Z line because the Z output pins of disabled ICs 4 and 6 are at high impedances.

The C# square wave released by the data selector is inverted by NAND gate IC12C. This inverted signal travels to pin 12 of IC12D as well as to pin 11 of IC15. IC15 divides the C# bass signal by 2 twice. The resultant signal from the first stage of division leaves IC15 at pin 13 and enters NAND gate IC12A at pin 2; the signal from the second stage leaves IC15 at pin 1 and enters IC12 at pin 6.

At this time the highest C# frequency (high bass) is available at IC12D, the second highest C# frequency (medium bass) is available at IC12A, and the lowest C# frequency (low bass) is available at IC12B. The NAND gates of IC14, however, will not pass the low, medium or high bass signals unless pins 5, 1, and 13 receive logic 1 (grd) levels. To determine if these inputs exist, we must examine the operation of octave select circuitry IC13 and transistors Q5 and Q6.

Because the C# pedal is within the group of pedals 1 through 5, both the keydown data buss (S) and the bass select data buss (R) are held at logic 1's (grd) during pedal down. IC13D NANDS these two logic 1's (grd) levels. This forces a logic 0 (—14V) at pin 11 of IC13D. IC13C then NANDS the logic 0 (—14V) from IC13D with the logic 1 (grd) from the kedydown buss producing a logic 1 (grd) output at IC13C pin 10. Now the logic 0 (—14V) from IC13 pin 11 and the logic 1 (grd) from IC13 pin 10 force flip-flop IC13A/13B to produce a logic 1 (grd) at pin 3 and a logic 0 (—14V) at pin 4. The output from pin 3 is applied to transistors Q5 and Q6, and the output from pin 4 is applied to IC12D.

With the 16'/8' tab set for the 16' mode (normal), J506 pin 2 of the Bass Generator Board receives —14VDC (logic 0). This potential is inverted by transistor Q6. Thus, both the inputs of Q6 and IC13A hold IC12A pin 1 to a logic 1 (grd) level. (Refer to schematic of Bass Generator Board).

Also, because the 16'/8' tab is set for 16', J506 pin 1 receives no input from the 16'/8' tab. Therefore, transistor Q5 becomes self biased and produces a logic 1 (grd) at its collector. This logic 1 (grd) is applied to pin 5 of IC12D.

Because both IC12B pin 5 and IC12A pin 1 are held to logic 1 (grd) levels, IC12B and IC12A pass the inverted low bass and medium bass C# signals to the envelope gates of IC14A pin 2 and IC14B pin 5 respectively. IC12D cannot pass the high bass C# frequency to IC14C because IC13B is holding pin 13 of IC12D to a logic 0 (—14V) level.

NAND gates IC14A and 14B cannot pass the low and medium bass frequencies until envelope generator Q4 sends logic 1 (grd) gating pulse to their input pins 1 and 6. The generation of the logic 1 (grd) gating pulse begins at the keydown data buss (S). When any pedal is depressed, a logic 1 (grd) appears at the keydown buss which is felt at pins 12 and 13 of NAND gate IC14D. IC14D inverts the logic 1 (grd) to a logic 0 (—14V) and sends this level from pin 11 to the base of transistor Q3 (refer to schematic of Bass Generator Board).

Transistor Q3 turns on with the application of —14V on its base. As Q3 conducts, it immediately charges capacitor C3 and forces transistor Q4 into conduction as well. With transistor Q4 conducting, a load is applied to resistor R11 which forces the junction of R11 and R12 to rise from —14V to —7V. The —7V is reduced by three 560K resistors before being applied to pins 1 and 6 of IC14 sections A and B. Thus, pins 2 and 6 feel logic 1 (grd) potential as long as the pedal remains depressed. As a result, IC14A and 14B pass the low and medium bass tones into the RC mute filters.

When the pedal is released with String Bass "OFF", transistor Q3 shuts off and capacitor C3 discharges quickly through the parallel combination R9 and R10. With String Bass 1 "ON", the capacitor discharges through the parallel combination of R9 and R10 in series with a 180K resistance. Finally, with String Bass II "ON", the capacitor discharges through the parallel combination of R9 and R10 in series with an 820K resistance.

The availability of these various discharge time constants allows control over the conduction time of transistor Q4, which in turn, controls the passing of bass tones through the envelope gates of IC14.

As the low and medium bass tones leave IC14, they become filtered by an RC network before reaching the bass of amplifier Q10. With the mute switch in the off position, transistors Q8 and Q9 receive no forward bias from J506 pin 4, and they allow maximum signal to transfer from the filter to the bass of Q10. When mute is selected, the transistors receive —14V from pin 4; they conduct and shunt a portion of the signals away from transistor Q10.

EXAMPLE #2 - MODE #2

Assuming that pedal #8 (G) is depressed and the 16'/8' stop is set for 16', the following operation occurs:

Note selection at the data selector ICs occurs in the same manner as example #1 except:

- priority encoder IC3 receives the logic 1 (grd) keying input at its D5 pin 4.
- data selector IC4 receives a 1, 0, 1 code at its A, B, and C inputs while ICs 5 and 6 are inhibited. As a result IC4 passes the low G clock from its X5 input to the Z output buss.

IC12C receives the low G square wave from the Z line and sends it to the divider IC15 to form the low and medium octaves of G. Consequently, the low bass is available at pin 6 of IC12B, the medium bass G is available at pin 2 of IC12A, and the high bass G is available at pin 12 of IC12D. The NAND gates of IC12, however, cannot pass the three signals until they receive octave select inputs at pins 5, 1, and 13 from the octave select circuitry of IC13, Q5 and Q6.

Because pedal #8 is within the 6-13 group of pedals, the depression of pedal

#8 forces a logic 1 (grd) at the keydown data buss (S) and a logic 0 (—14V) at bass select data buss (R). This combination yields a logic 1 (grd) at the pin 11 output of IC13D. The logic 1 (grd) at pin 11 is sent to pin 1 of IC13A and pin 9 of IC13C. IC13C NANDS the logic 1 (grd) from IC13D and the logic 1 (grd) from the keydown buss to produce a logic 0 (—14V) at its output pin 10. Now with pin 1 of IC13A at logic 1 (grd) and pin 6 of IC13B at logic 0 (—14V) flip-flop IC13A/13B produces a logic 1 (grd) at its pin 4 and pin 0 (—14V) at its pin 3.

The two outputs of the flip-flop combine with the inputs of the 16'/8' tab to allow the medium bass G frequency and the high bass G frequency to pass through IC12A and IC12D to enter the envelope gates of IC14B and IC14C. IC12D directly receives the logic 1 (grd) gating input at pin 13 from IC13B. IC12A receives a logic 1 (grd) at its gating input (pin 1) from conducting transistor Q6. IC12B is inhibited because the logic 0 (—14V) from pin 3 of IC13A overrides the logic 1 (grd) from transistor Q5. (Refer to schematic of the Bass Generator Board).

After the medium and high bass signals reach the envelope NAND gates of IC14, the signals undergo the same process that was explained in example #1.

EXAMPLE #3 - MODE #3

Assuming that pedal #2 is depressed and the 16'/8' stop is set for 8' the following operation occurs:

The note selection process of the C# bass tone from data selector IC5 is accomplished in exactly the same manner as that described in example #1. Likewise, the C# low, medium, and high bass tones are made available at IC12 at its respective B, A, and D selections. But, with the 16'/8' tab set for the 8' mode, the octave select gates of IC13, transistor Q5, and transistor Q6 enable the medium and high bass gates IC12 and IC12D and disable the low bass gate IC12B.

Because both the keydown data buss (S) and the bass select data buss (R) are held to logic 1 (grd) levels with pedal #2 depressed, flip-flop IC13A/13B provides a logic 0 (—14V) at its pin 4 ouput and a logic 1 (grd) at its pin 3 output. Even through transistor Q6 is shut off in 8' mode, the logic 1 (grd) output of IC13A maintains pin 1 of IC12A at ground potential. This enables the medium bass gate. (Refer to board schematic).

Transistor Q5 maintains cutoff potential in 8' mode. The transistor's high collector/emitter resistance develops a logic 0 (—14V) level and applies this level to pin 5 of IC12B. The logic 0 (—14V) at pin 5 disables the low bass gate.

After the medium and high bass signals leave the IC12, they enter the envelope gates of IC14 and follow the normal path through the RC mute filter and transistor Q10.

EXAMPLE #4 - MODE #4

Assuming that pedal #8 is depressed and the 16'/8' stop is set for 8' the following operation occurs:

The G low, medium and high bass tones are applied to the bass select gates of IC12B, A, and D in the normal manner. Because pedal #8 is depressed the keydown data buss (S) goes to logic 1 (grd) and the bass select data buss goes to a logic 0 (—14V). These levels force pin 3 of IC13A to fall to the logic 0 (—14V) level and pin 4 of IC13B to rise to the logic 1 (grd) level.

Because the 16'/8' tab is set for 8', the outputs of the IC13A/13B flip-flop combine with the "floating" and logic 1 (grd) potentials at J506 pins 2 and 1 respectively and force pins 5 and 1 of IC12B and IC12A to logic 0 (—14V) levels. This action allows only the high bass gate of IC12D to become active and pass a signal to the envelope gates.

EXAMPLE #5 - MODE #5

Assuming the bass to lower tab is set for the "ON" position and lower manual key #20 (C) is depressed, the following action occurs:

With the bass to lower tab on, ground is removed from the pedal assembly and applied to a buss bar in the lower manual assembly. This rearrangement of ground disables the pedals and enables the first 20 lower manual keys for bass keying.

When the lower manual keys 1-20 are depressed in bass mode, J505, J504 and J503 receive logic 1 (grd) keying inputs. These keying inputs travel through the diode matrix and key the priority encoder ICs. Lower manual key #20, for instance, places a logic 1 (grd) at the D4 input of IC1. The note select process from this encoder stage to the data selector stage operates in the same manner as that of the pedal mode.

With lower manual key #20 depressed the high C bass frequency at the X4 input of IC6 is released at the Z output line. This frequency travels through IC12C reaches IC12 pin 12 as the high bass signal, and clocks IC15 to form the medium and low bass signals at IC12A pin 2 and IC12B pin 6.

As in the pedal modes, IC12 does not pass any signals to the envelope gates of IC14 until the bass select circuitry (IC13, Q5, and Q6) releases logic 1 (grd) levels to the gating inputs of IC12 pins 5, 1, or 13.

Also with lower manual key #20 activated, the keydown data buss rises to logic 1 (grd) level and the bass select buss (R) remains at logic 0 (—14V). This combination of inputs at NAND gate IC13D forces flip-flop IC13A/13B to hold a logic 0 (—14V) level at its pin 3 output and a logic 1 (grd) level at its pin 4 output. The pin 3 output of logic 0 (—14V) holds IC12B in a disabled mode and the pin 4 output holds IC12D operational.

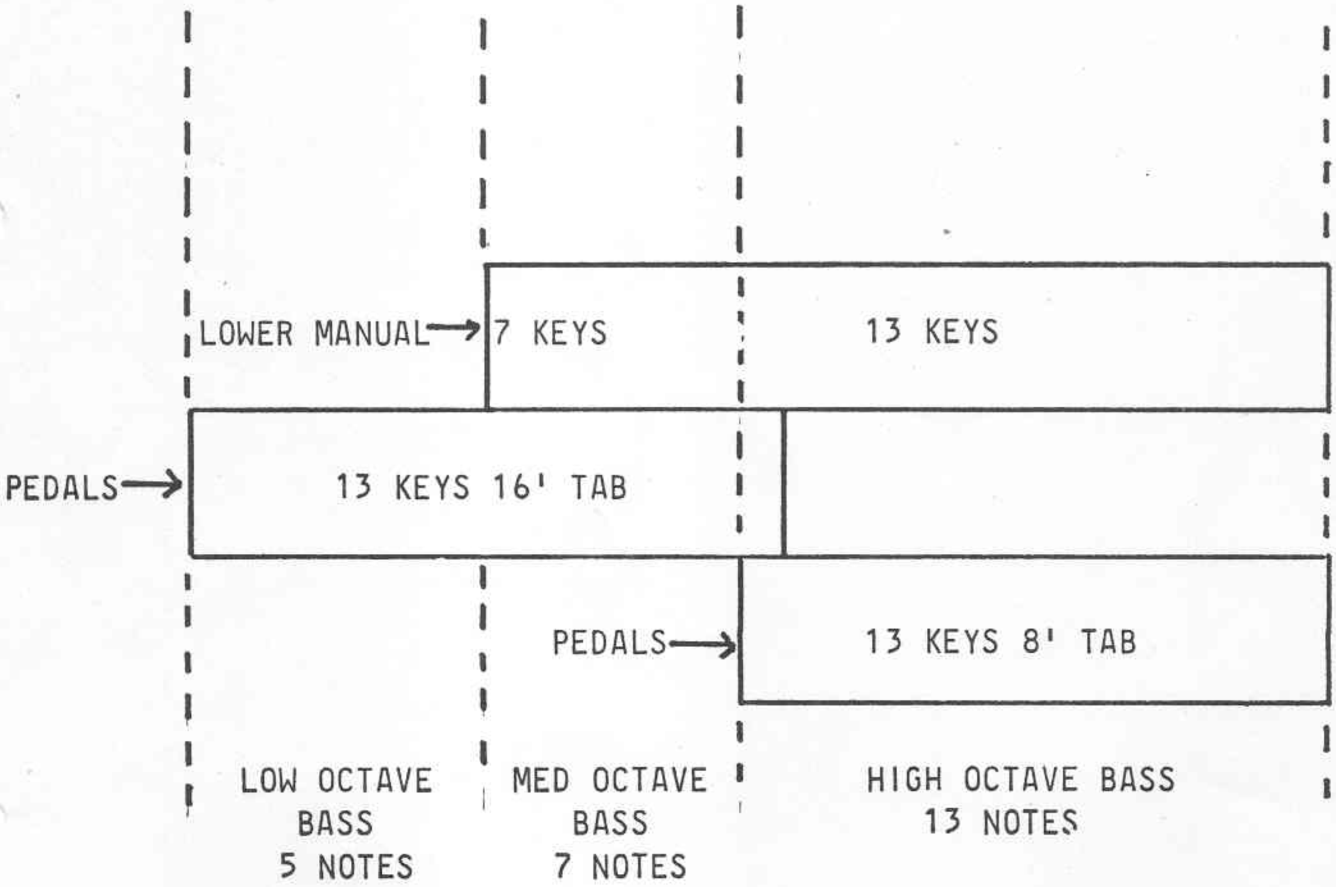
Also, because the bass to lower tab is actuated, transistor Q6 receives —14V at its base input. This potential turns Q6 on which allows pin 1 of IC12A to maintain a logic 1 (grd) level. Consequently IC12A passes the medium bass signal gate.

The result of holding lower manual key #20 down when the bass to lower coupler is on is the passing of the

medium and high bass C tones from the bass select gates of IC12 to the envelope gates of IC14. At this point the system processes the signal in the normal fashion.

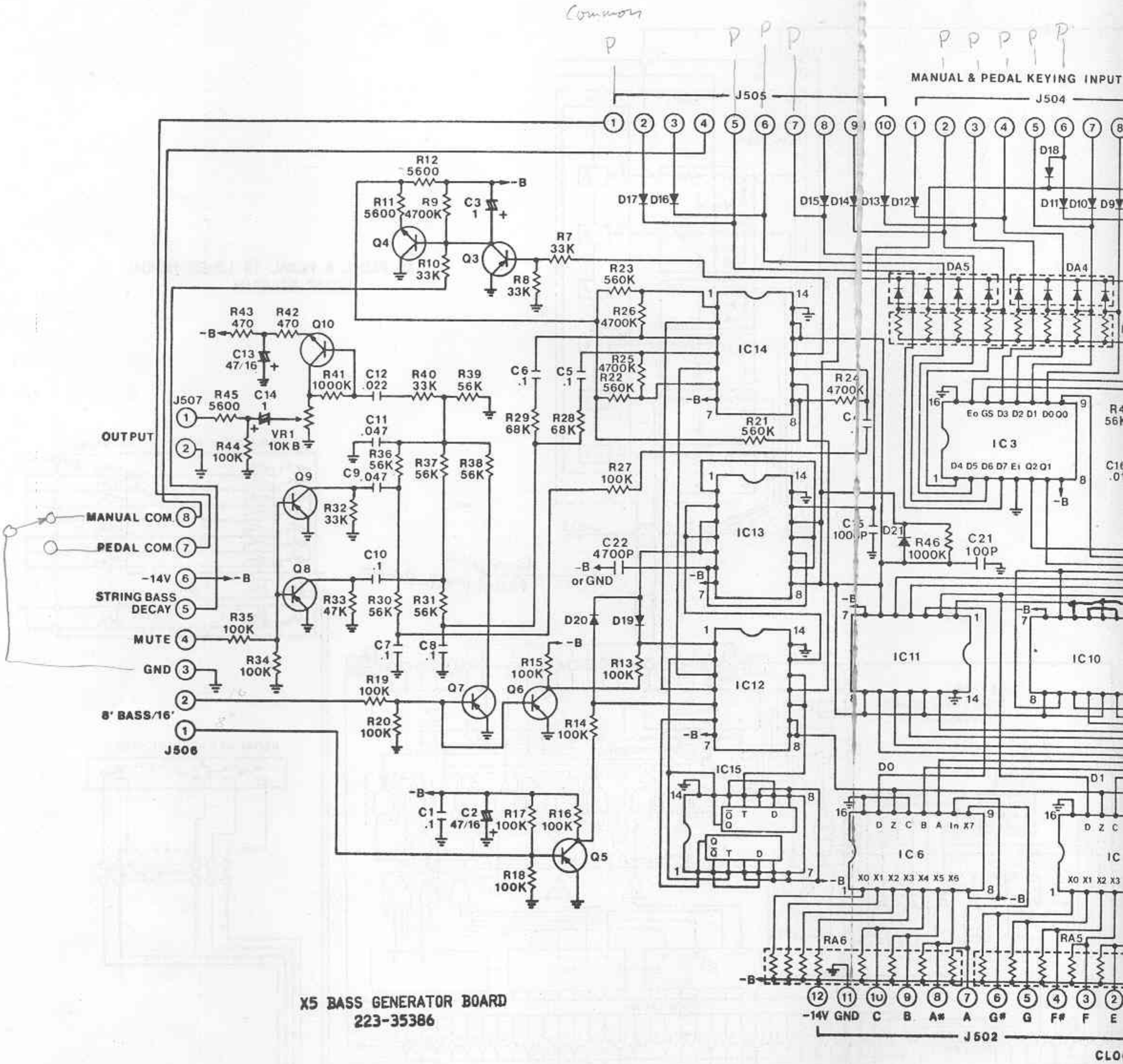
NOTE: All 20 lower manual keys utilize only the medium and high bass outputs of IC12A and IC12D.

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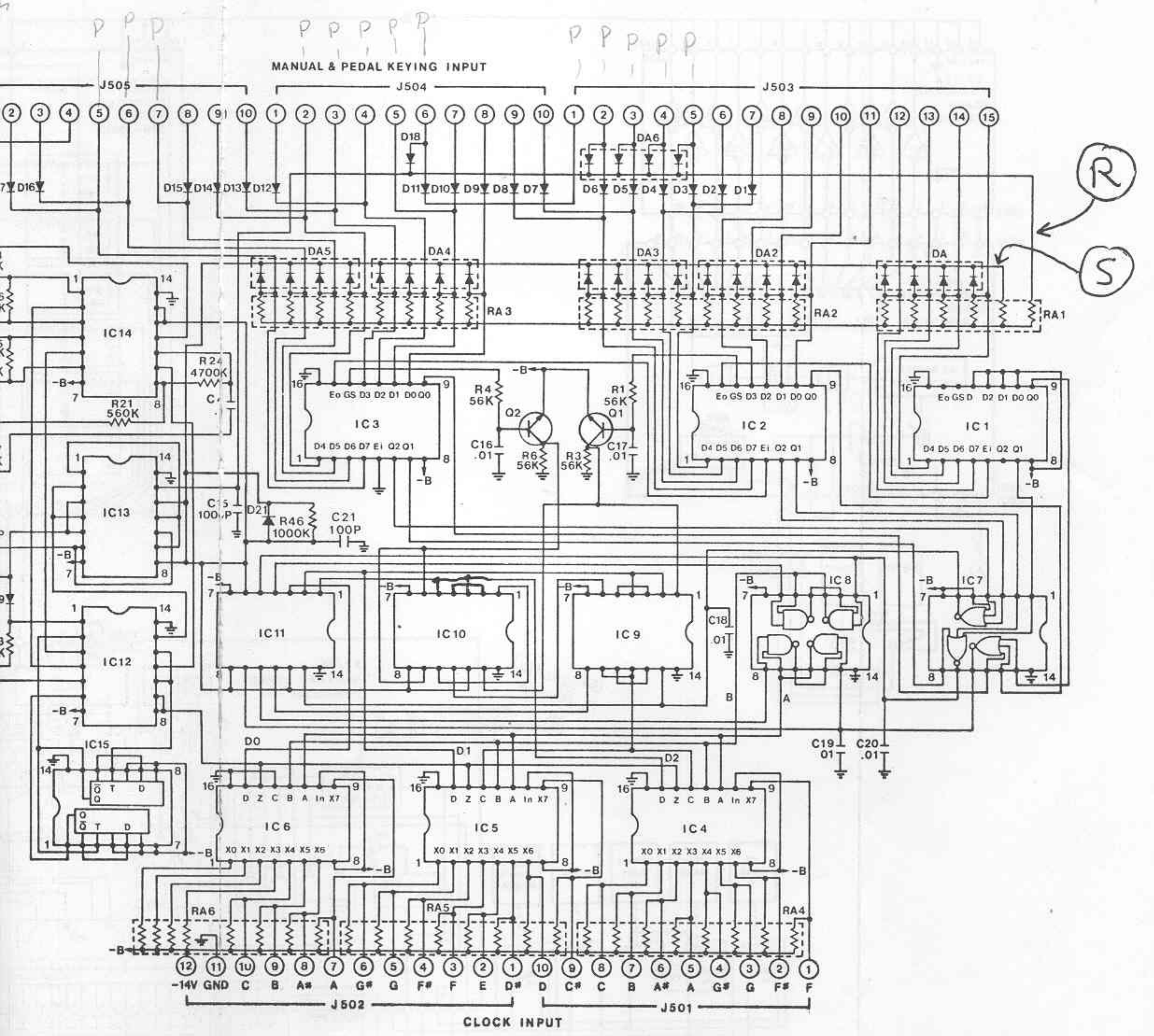


X5 BASS RANGE

Figure 1



X5 BASS GENERATOR BOARD
223-35386



MANUAL & PEDAL KEYING INPUT
J505
J504
J503
DA5
DA4
RA3
DA3
DA2
RA2
DA
RA1
IC14
IC13
IC12
IC15
IC3
IC2
IC1
IC11
IC10
IC9
IC8
IC7
IC6
IC5
IC4
R24 4700K
R21 560K
R4 56K
R1 56K
R6 56K
R3 56K
Q2
Q1
C16 .01
C17 .01
C15 100P
D21
R46 1000K
C21 100P
C18 .01
C19 .01
C20 .01
D18
DA6
D16
D15 D14 D13 D12
D11 D10 D9 D8 D7
D6 D5 D4 D3 D2 D1
D0
D1
D2
RA6
RA5
RA4
-14V GND C B A# A G# G F# F E D#
D C# C B A# A G# G F# F
J502
J501
CLOCK INPUT
R
S

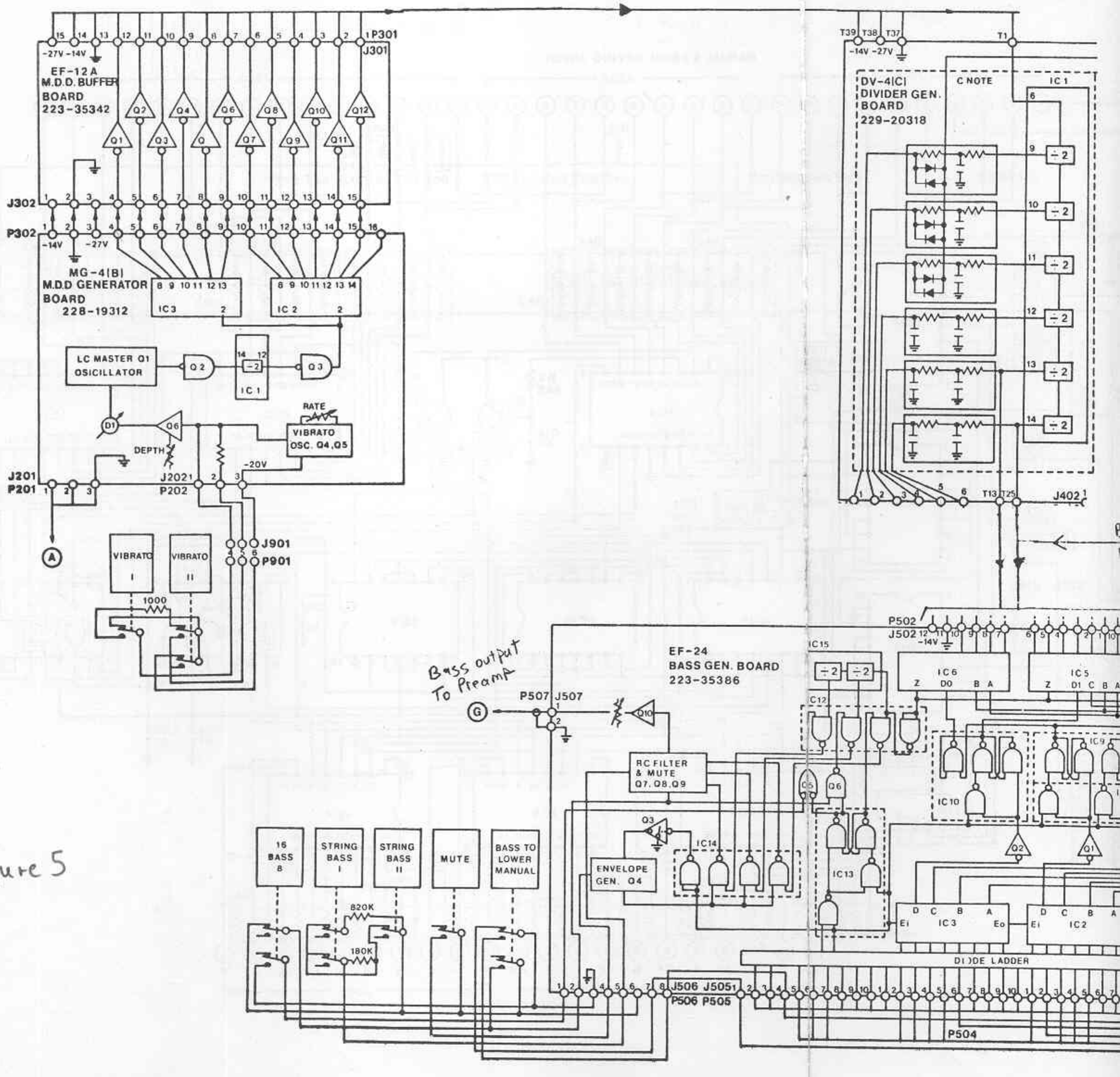
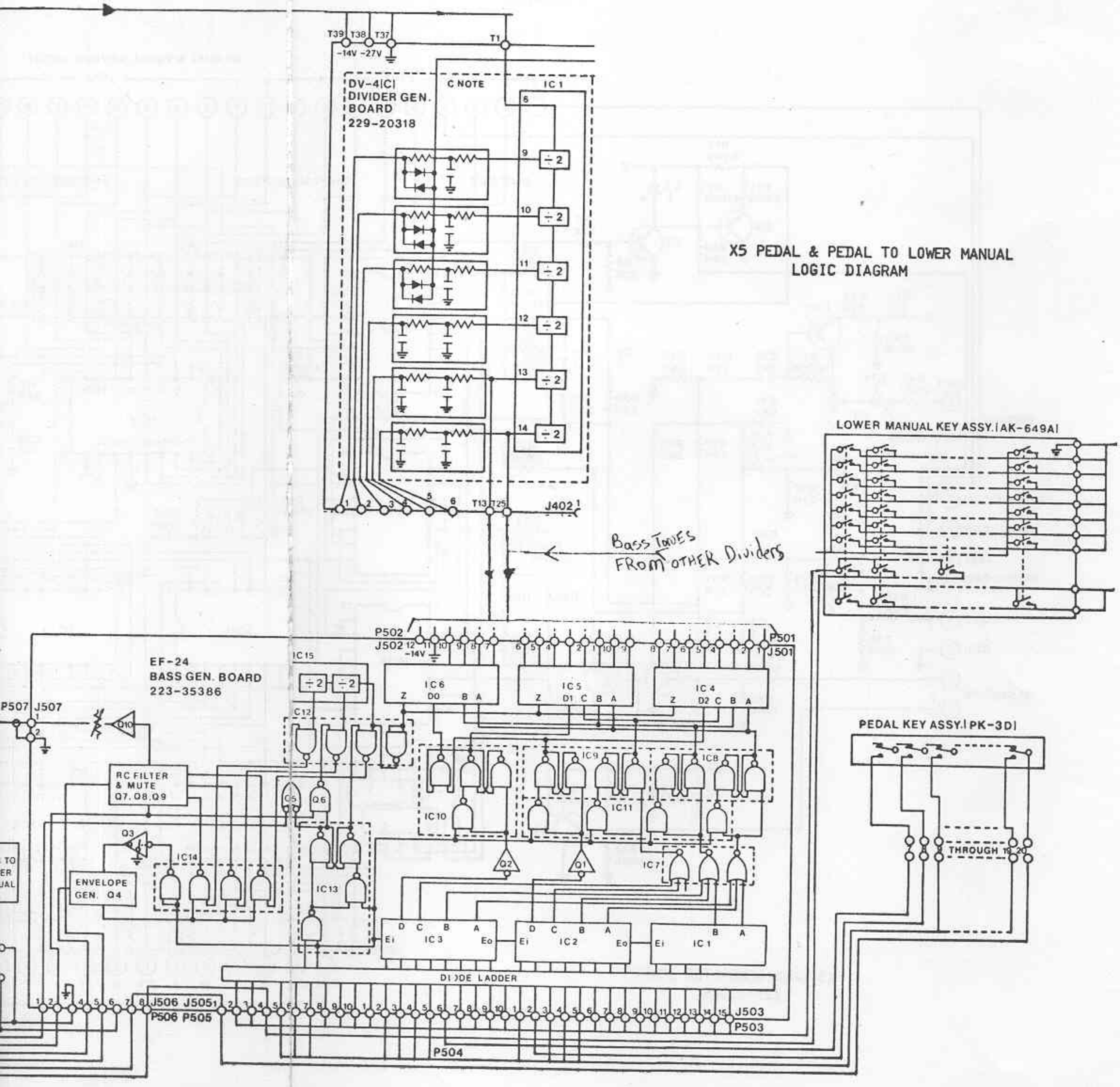

EF-12A
M.D.D. BUFFER
BOARD
223-35342
P301
J301
J302
P302
MG-4(B)
M.D.D GENERATOR
BOARD
228-19312
IC3
IC2
LC MASTER Q1
OSCILLATOR
IC1
RATE
VIBRATO
OSC. Q4,Q5
DEPTH
-20V
J201
P201
J202
P202
J901
P901
VIBRATO
I
VIBRATO
II
1000
DV-4(C)
DIVIDER GEN.
BOARD
229-20318
C NOTE
J402
P502
J502
EF-24
BASS GEN. BOARD
223-35386
Bass output
To Preamp
P507
J507
RC FILTER
& MUTE
Q7, Q8, Q9
ENVELOPE
GEN. Q4
IC14
IC13
IC12
IC15
IC6
IC5
IC10
IC9
IC3
IC2
DIODE LADDER
16
BASS
8
STRING
BASS
I
STRING
BASS
II
MUTE
BASS TO
LOWER
MANUAL
820K
180K
J506
J505
P506
P505
P504

Figure 5

X5 PEDAL & PEDAL TO LOWER MANUAL LOGIC DIAGRAM



X5 BASS GENERATOR BOARD

FUNCTIONAL BLOCK DIAGRAM FOR PEDALS AND PEDALS TO

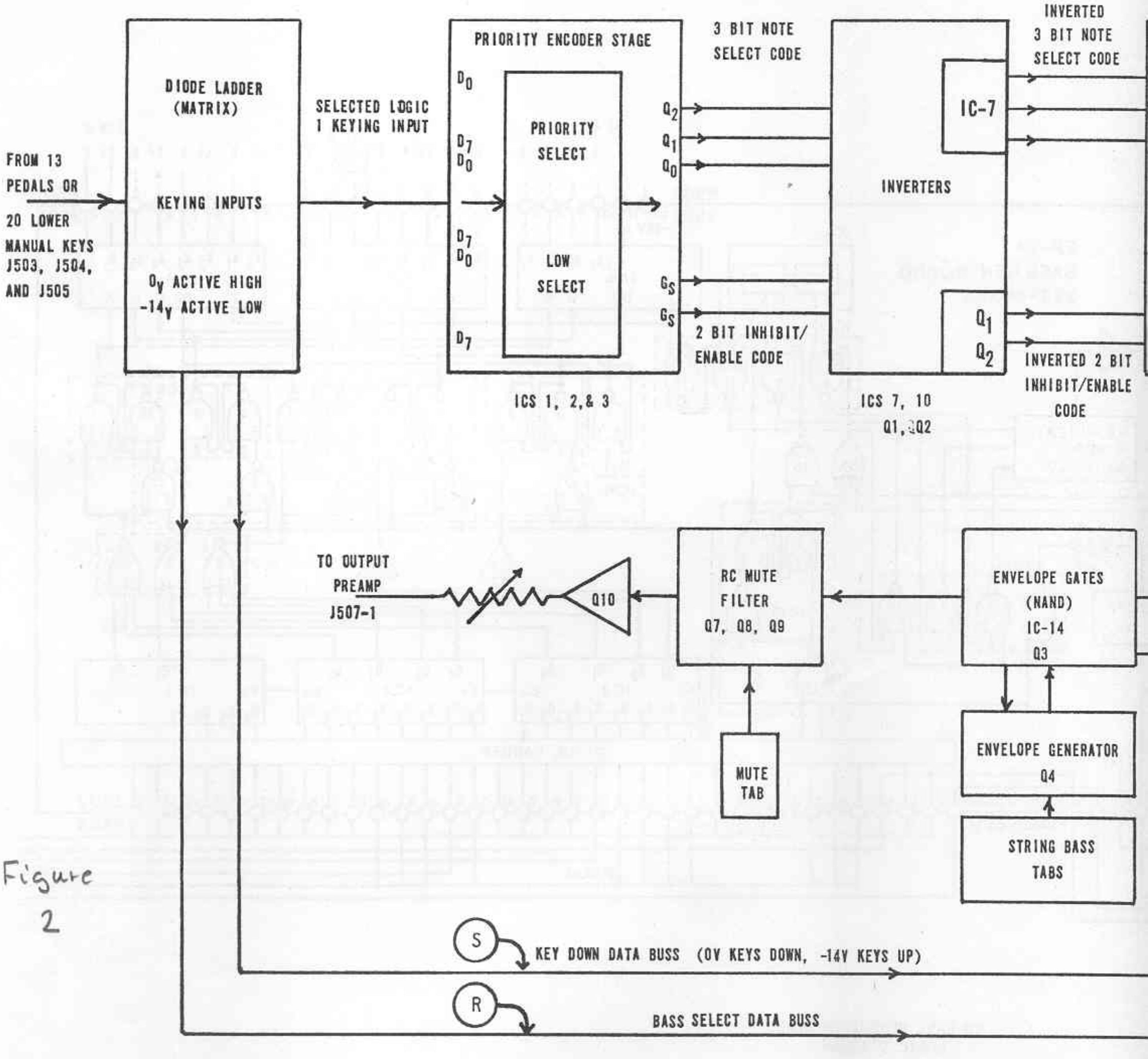
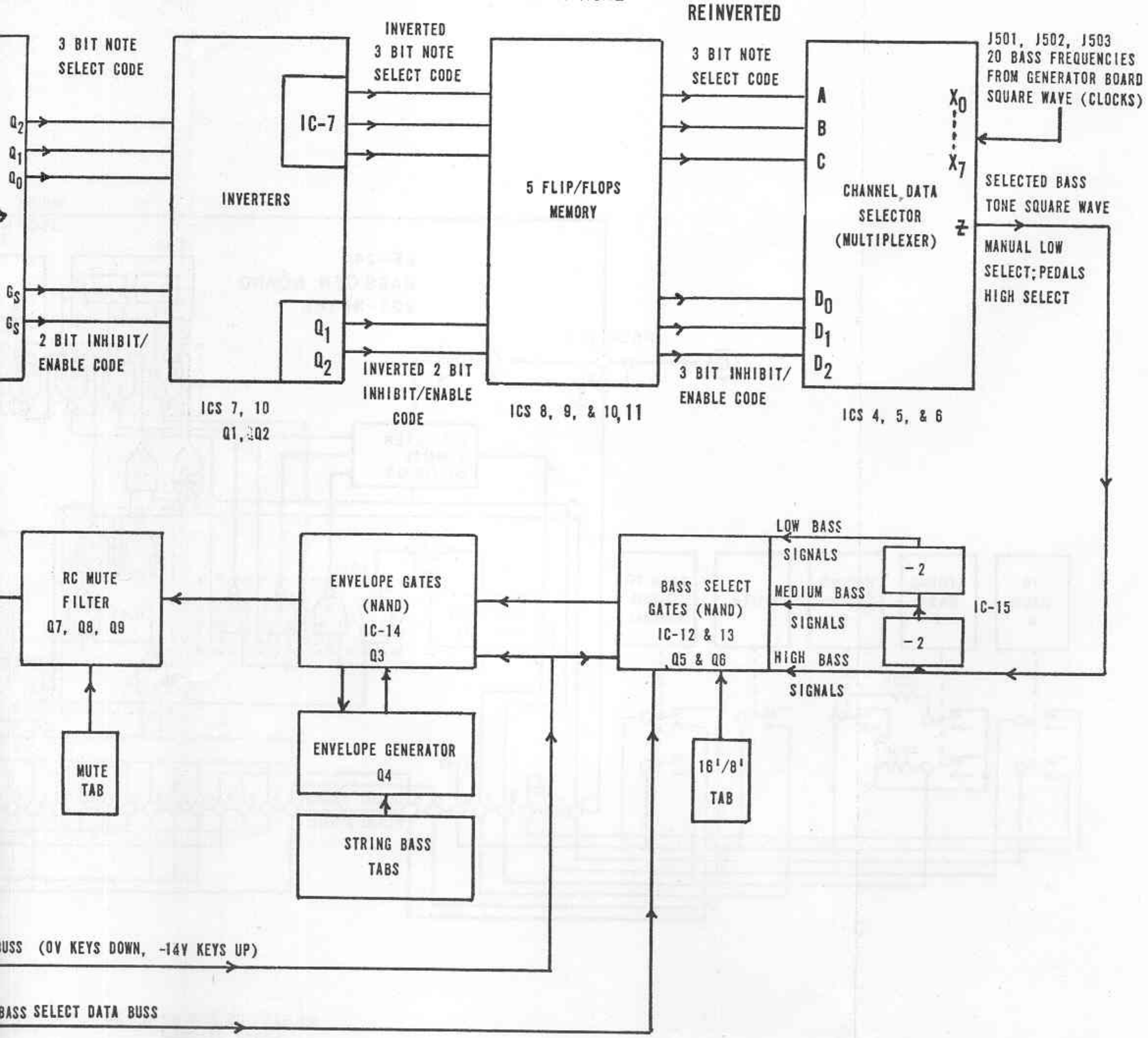


Figure 2

X5 BASS GENERATOR BOARD

ONAL BLOCK DIAGRAM FOR PEDALS AND PEDALS TO LOWER MANUAL



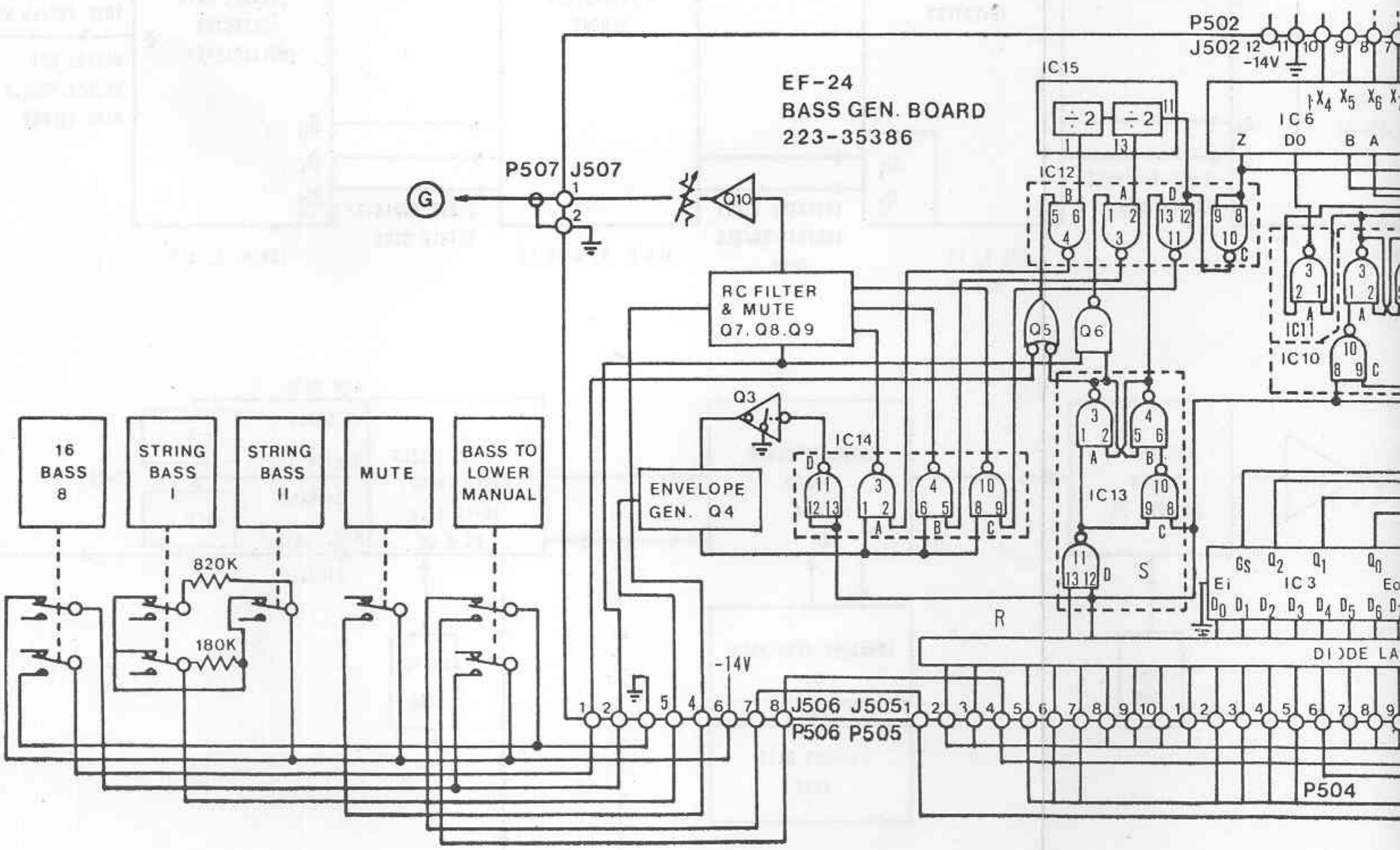
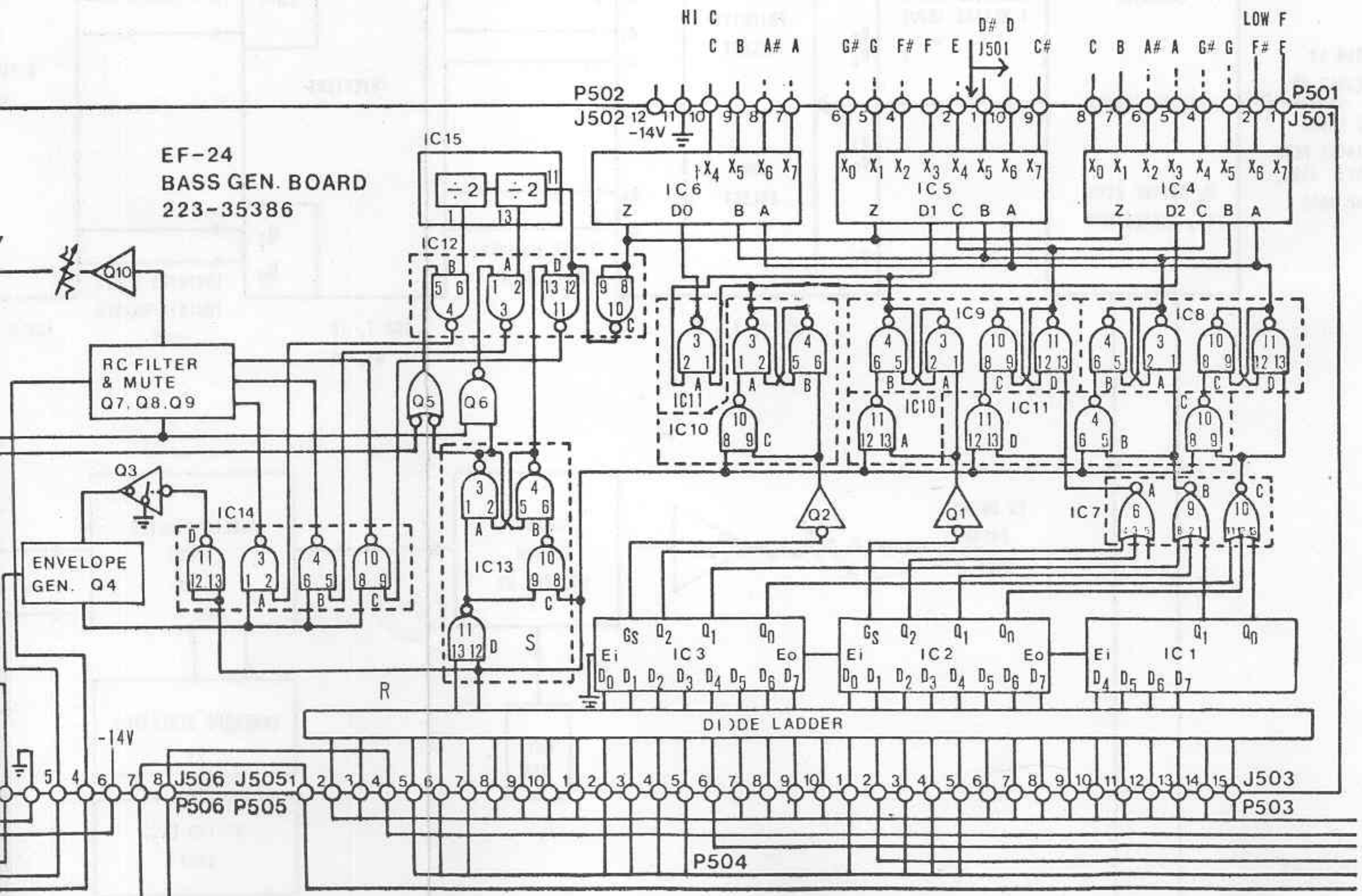
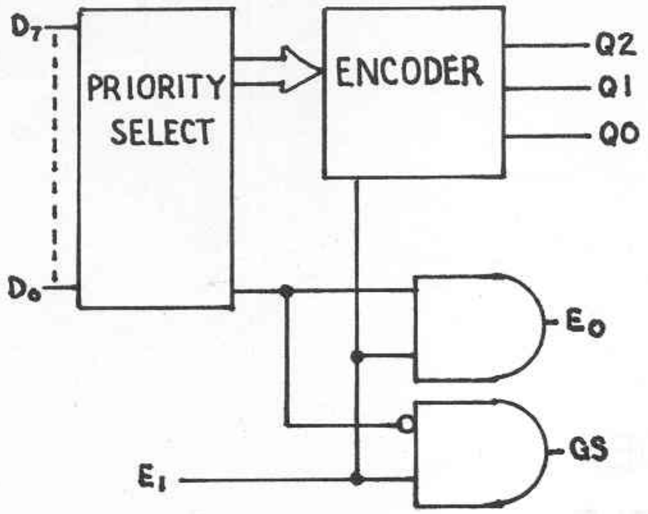


Figure 3

X5 BASS GENERATOR BOARD
LOGIC DIAGRAM



X5 BASS GENERATOR BOARD
LOGIC DIAGRAM

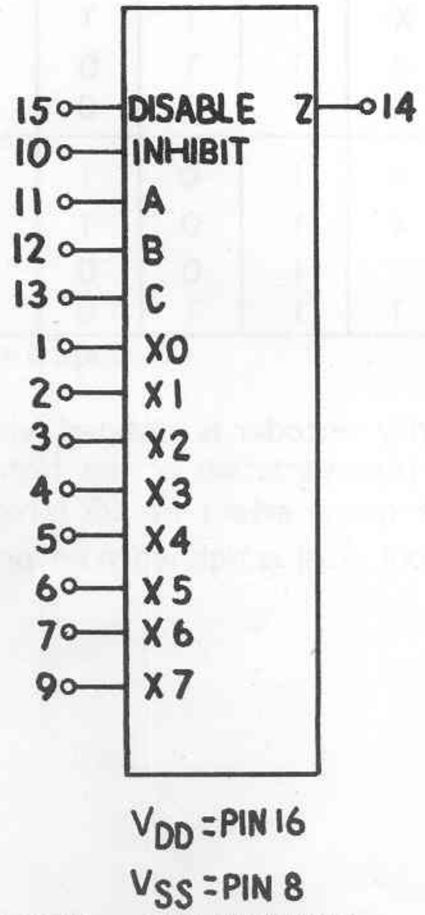


8 BIT ENCODER

HAMMOND PART NUMBER J 319-009001

MOTOROLA NUMBER MC 14532 CP

RCA NUMBER CD 4532 E



DATA SELECTOR

HAMMOND PART NUMBER J 319-010001

MOTOROLA NUMBER MC 14512 CP

Figure 6

8-BIT ENCODER

TRUTH TABLE

INPUT									OUTPUT				
E_I	D7	D6	D5	D4	D3	D2	D1	D0	GS	Q2	Q1	Q0	E_O
0	X	X	X	X	X	X	X	X	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	1
1	1	X	X	X	X	X	X	X	1	1	1	1	0
1	0	1	X	X	X	X	X	X	1	1	1	0	0
1	0	0	1	X	X	X	X	X	1	1	0	1	0
1	0	0	0	1	X	X	X	X	1	1	0	0	0
1	0	0	0	0	1	X	X	X	1	0	1	1	0
1	0	0	0	0	0	1	X	X	1	0	1	0	0
1	0	0	0	0	0	0	1	X	1	0	0	1	0
1	0	0	0	0	0	0	0	1	1	1	0	0	0

X = Don't Care Logic 1 = High Logic 0 = Low

D7 is the highest priority and D0 is the lowest. The priority encoder is inhibited when the chip-enable input E_I is low. When E_I is high, the binary representation of the highest priority input appears on output lines Q2-Q0, and the group select line GS is high to indicate that priority inputs are present. The enable-out (E_O) is high when no priority inputs are present.

Figure 7

8-CHANNEL DATA SELECTOR

4512

TRUTH TABLE

C	B	A	INHIBIT	DISABLE	Z
0	0	0	0	0	X0
0	0	1	0	0	X1
0	1	0	0	0	X2
0	1	1	0	0	X3
1	0	0	0	0	X4
1	0	1	0	0	X5
1	1	0	0	0	X6
1	1	1	0	0	X7
ø	ø	ø	1	0	0
ø	ø	ø	ø	1	High Impedance

Figure 8

X-5 PRIORITY SELECT INPUTS

L/M KEY	# 1	F Note	J505-2	D7 of IC3 pin 4
	# 2	F# Note	J505-3	D6 of IC3 pin 3
	# 3	G Note	J505-7	D5 of IC3 pin 2
	# 4	G# Note	J505-9	D4 of IC3 pin 1
	# 5	A Note	J505-10	D3 of IC3 pin 13
	# 6	A# Note	J504-1	D2 of IC3 pin 12
	# 7	B Note	J504-5	D1 of IC3 pin 11
	# 8	C Note	J504-8	D0 of IC3 pin 10
	# 9	C# Note	J504-9	D7 of IC2 pin 4
	#10	D Note	J504-10	D6 of IC2 pin 3
	#11	D# Note	J503-6	D5 of IC2 pin 2
	#12	E Note	J503-7	D4 of IC2 pin 1
	#13	F Note	J503-8	D3 of IC2 pin 12
	#14	F# Note	J503-9	D2 of IC2 pin 11
	#15	G Note	J503-10	D1 of IC2 pin 10
	#16	G# Note	J503-11	D0 of IC2 pin 9
	#17	A Note	J503-12	D7 of IC1 pin 4
	#18	A# Note	J503-13	D6 of IC1 pin 3
	#19	B Note	J503-14	D5 of IC1 pin 2
	#20	C Note	J503-15	D4 of IC1 pin 1
PEDAL KEY	# 1	C Note	J503-1	D0 of IC3 pin 10
	# 2	C# Note	J503-2	D7 of IC2 pin 4
	# 3	D Note	J503-3	D6 of IC2 pin 3
	# 4	D# Note	J503-4	D5 of IC2 pin 2
	# 5	E Note	J503-5	D4 of IC2 pin 1
	# 6	F Note	J505-5	D7 of IC3 pin 4
	# 7	F# Note	J505-6	D6 of IC3 pin 3
	# 8	G Note	J505-7	D5 of IC3 pin 2
	# 9	G# Note	J504-2	D4 of IC3 pin 1
	#10	A Note	J504-3	D3 of IC3 pin 13
	#11	A# Note	J504-4	D2 of IC3 pin 12
	#12	B Note	J504-5	D1 of IC3 pin 11
	#13	C Note	J503-1	D0 of IC3 pin 10

Her er noget galt!

Something rotten!

Figure 9

NIHON HAMMOND SERVICE NEWS

NIHON HAMOND, LTD. · SERVICE DEPARTMENT
2-30, 2-chome, Shinkitajima, Suminoe-ku, Osaka, Japan 〒559

Volume 1 Number 1

SEPTEMBER 1977

NEW X-5 CHANGES

Eight new pages for the NEW X-5 (18150K) Appendix HO-I296A are enclosed.
These pages should be inserted into your NEW X-5 (18150K) Appendix in place of the pages that are there now. Three of the pages, 3-8A·3-9A (ADD-1), 3-8A·3-9A (ADD-2) and 3-8A·3-9A (ADD-3), concern changes in the M.D.D. Genrator Board and the M.D.D. Buffer Board. Five of the pages, 3-13A (ADD-1), 3-15A (ADD-1), 3-16A (ADD-1), 4-7A (ADD-1) and 4-7A (ADD-2), concern changes in the Power Supply Unit and the Main Amp. Assy.

TWO NEW SERVICE SHEETS

Service information for two models is enclosed. A complete manual, H000-006023 JR for 123JMR and H000-006041 JR for 124JMR.

NIHON HAMMOND SERVICE NEWS

Volume 1 Number 1

SEPTEMBER 1977

MODEL NEW X-5 (18150K)

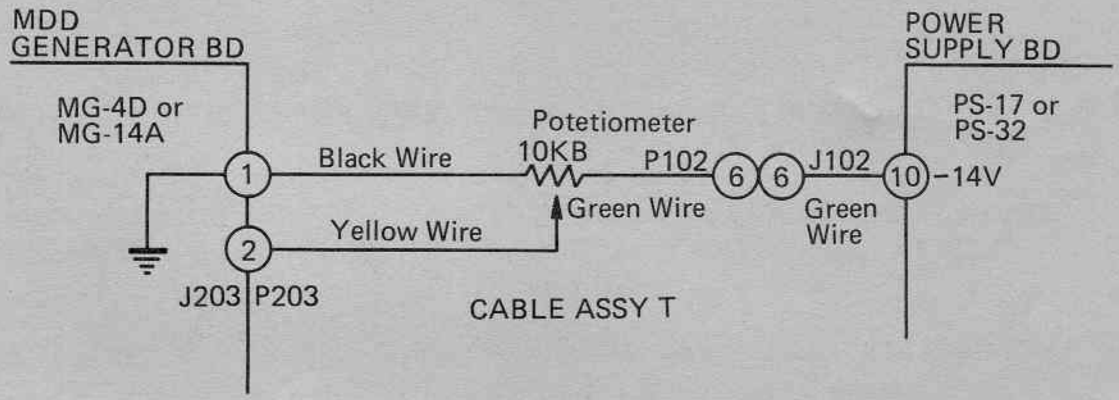
SUBJECT: MISPRINTED NEW X-5 (18150K) SERVICE MANUAL

CORRECTION: Refer to schematic (NOTES 1.) of 228-19312 M.D.D. Generator Board on Page 3-8A in NEW X-5 (18150K) service manual HO-1296A.

WRONG:	Q1	305-03014	2SC373
	Q2 THROUGH Q6	305-03040	2SC945Q
RIGHT:	Q1 THROUGH Q3	305-03063	2SC1675L or K
	Q4 THROUGH Q6	305-03040	2SC945Q

SUBJECT: ADD PITCH CONTROL IN 220V & 240V AREA
(Serial No. 572263 Up)

See detail as follows.



CAUTION: MG-4D is added pin-terminal 2P (J203) to MG-4B.

PARTS:

Pin Terminal 2P (J203)	317-03081	5028-2A
Cable Assy T	105-03421	
Connector 2P (P203)	317-03001	2139-2
Connector Pin (for P203)	317-03009	2478-TL
Connector Pin (for P102)	314-07001	1380-TL
Potentiometer 10KB	309-17002	EVC-BOA-S15
Blind #2	401-02418	
Bracket	401-03497	
Potentiometer Knob	304-02047	FT-20S

SUBJECT: ADD NEW TYPE M.D.D. GENERATOR BOARD IS USED 1-CHIP LSI (S-50240) Except 120V Area

Refer to Appendix Page 3-8A·3-9A (ADD-1), 3-8A·3-9A (ADD-2) and 3-8A·3-9A (ADD-3).

NIHON HAMMOND SERVICE NEWS Volume 1 Number 1

SEPTEMBER 1977

MODEL NEW X-5 (18150K)

SUBJECT: ADD NEW TYPE POWER SUPPLY UNIT & MAIN AMP ASSY

Refer to appendix Pages 3-13A (ADD–1), 3–15A (ADD–), 3–16A (ADD–1), 4-7A (ADD-1) and 4-7A (ADD-2).

SUBJECT: CIRCUIT CHANGES ON NEW TYPE MAIN AMP ASSY IN 220V & 240V AREA

CORRECTION: Changes Value of Fuses F1 and F2 (1AT) to 1.6 AT on the 224-15211 PS-34 Fuse Board in the New Type Main Amp Assy. (Serial No. 572263 Up)

SUBJECT: CIRCUIT CHANGES ON NEW TYPE POWER SUPPLY UNIT IN 220V & 240V AREA

CORRECTION: Changes value of Fuses F1 and F2 (0.63A) to 315 mAT on the 224-15206 PS-33 Fuse Board in the New Type Power Supply Unit (Serial No. 578268 Up and No.580591 Down)

CORRECTION: Changes value of Fuses F1 and F2 (315 mAT) to 400 mAT on the 224-15206 PS-33 Fuse Board in the New Type Power Supply Unit (Serial No. 580592 Up)

SUBJECT: BASS GENERATOR P.W.B. (EF-24) 223-35286 REVISION

For output level up. (Serial No. 02200 Up)

CORRECTION: Refer to schematic of 223-35386 Bass Generator Board on Page 3-7A in NEW X-5 service manual HO-1296A.

Change value of resistor R11 (5600) to 4700.

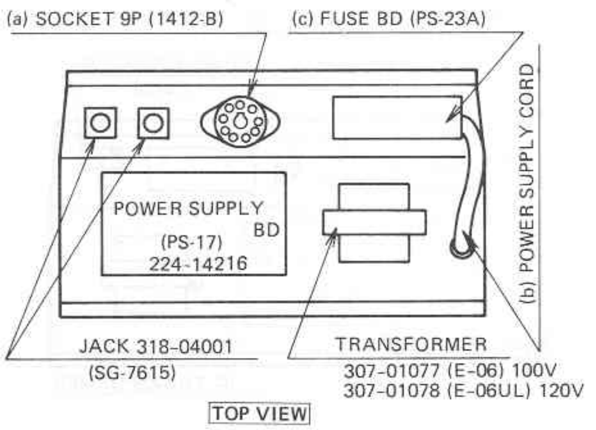
DIFFERENCE BETWEEN NEW TYPE AND OLD TYPE POWER SUPPLY UNIT

DIFFERENCE BETWEEN NEW TYPE AND OLD TYPE MAIN AMP. ASSY

≪ 100V & 120V AREA ≫

PRESENTED SERVICE MANUAL (OLD TYPE)	ADD (NEW TYPE)
POWER SUPPLY UNIT 105-09201 (100V) 105-09292 (120V)	POWER SUPPLY UNIT 105-09225 (100V) 105-09226 (120V)

PRESENTED SERVICE MANUAL (OLD TYPE) — POWER SUPPLY UNIT

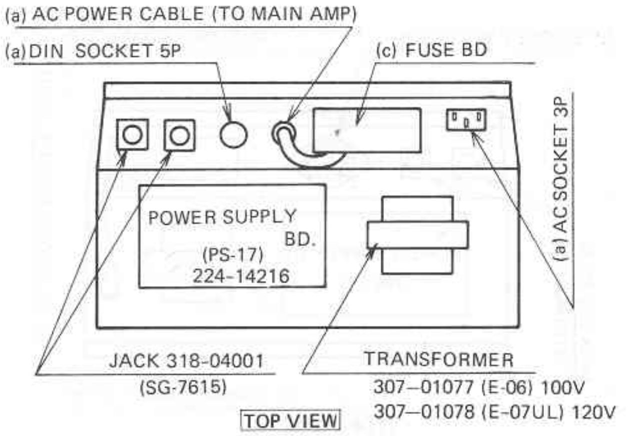


TOP VIEW

NOTE:

(a) Socket 9P	317-01015	(1412-B)
(b) Power Supply Cord	438-08001	100V only
Power Supply Cord	438-02021	120V only
(C) Fuse Board Assy	224-14241	(PS-23A)

ADD (NEW TYPE) — POWER SUPPLY UNIT



TOP VIEW

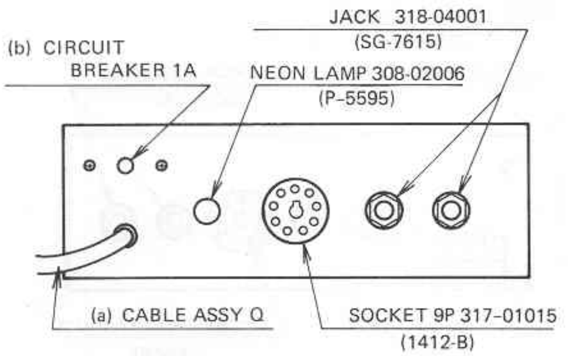
NOTE:

(a) DIN Socket 5P	303-14001	
AC Socket 3P	303-09005	(CM-3)
AC Power Cable	439-01008	(to Main Amp.)
(b) Power Supply Cord	439-02002	100V only
Power Supply Cord	439-01004	120V only
(C) Fuse Board Assy	224-14241	(PS-23A) 120V
Fuse Board Assy	224-14243	(PS-23C) 100V

CHANGE: SERIAL NO. 589442 Up (100V AREA)
SERIAL NO. 585539 Up (120V AREA)

PRESENTED SERVICE MANUAL (OLD TYPE)	ADD (NEW TYPE)
MAIN AMP. ASSY 105-09205 (100V) 105-09206 (120V)	MAIN AMP. ASSY 105-09229 (100V) 105-09230 (120V)

PRESENTED SERVICE MANUAL (OLD TYPE) — MAIN AMP. ASSY

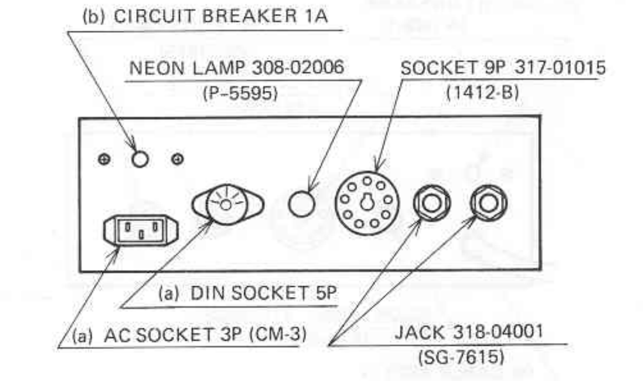


FRONT VIEW

NOTE:

(a) Cable Assy Q	105-07415	
(b) Circuit Breaker 1A	302-02020	(MB-1)

ADD (NEW TYPE) — MAIN AMP. ASSY



FRONT VIEW

NOTE:

(a) DIN Socket 5P	303-14001	
AC Socket 3P	303-09005	(CM-3)
DIN Cord	440-01002	
(b) Circuit Breaker 1A	302-02004	(NW-1S) CSA only
Circuit Breaker 1A	302-02020	(MB-1) UL & 100V only

CHANGE: SERIAL NO. 589442 Up (100V AREA)
SERIAL NO. 585539 Up (120V AREA)

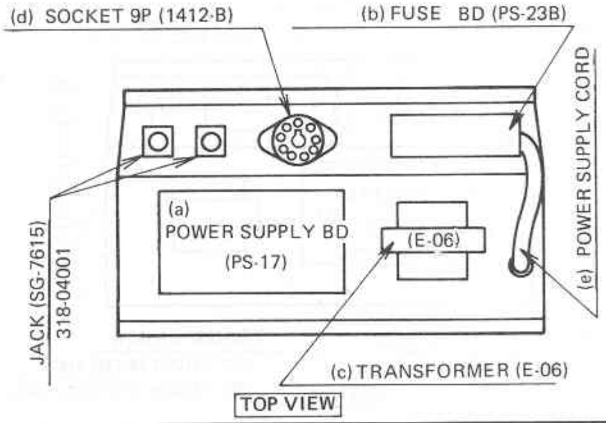
DIFFERENCE BETWEEN NEW TYPE AND OLD TYPE POWER SUPPLY UNIT

DIFFERENCE BETWEEN NEW TYPE AND OLD TYPE MAIN AMP. ASSY

≪ 220V & 240V AREA ≫

PRESENTED SERVICE MANUAL (OLD TYPE)

POWER SUPPLY UNIT 105-09204 (230V)

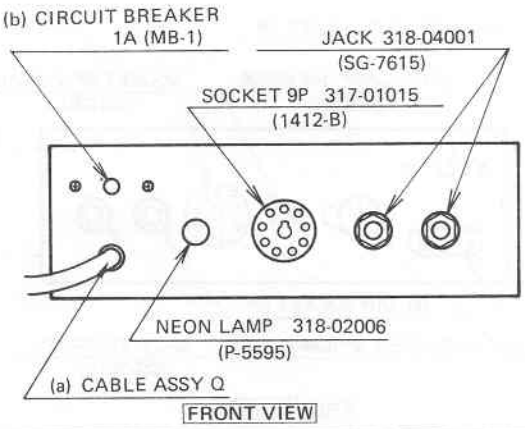


TOP VIEW

NOTE:

(a) Power Supply PWB Assy	224-14216	(PS-17)
(b) Fuse Boad Assy	224-14242	(PS-23B)
(c) Transformer (230V)	307-01077	(E-06)
(d) Socket 9P	317-01015	(1412-B)
(e) Power Supply Cord	504-12002	(230V)
Plug	316-03001	(230V)

MAIN AMP. ASSY 105-09207 (230V)



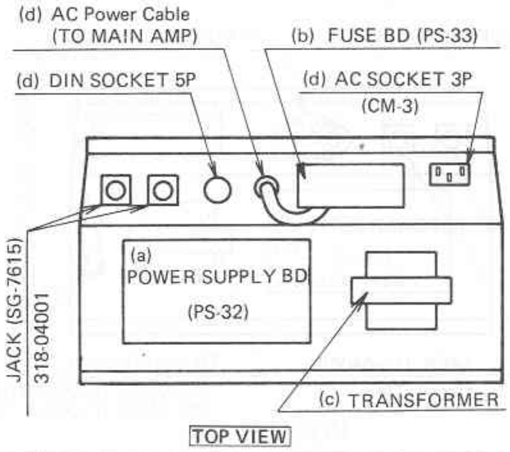
FRONT VIEW

NOTE:

(a) Cable Assy Q	105-07415	
(b) Circuit Breaker 1A	302-02004	(NW-1S)
(c) Transformer (230V)	307-01068	(E-05)

ADD (NEW TYPE)

POWER SUPPLY UNIT 105-09227 (220V) 105-09228 (240V)



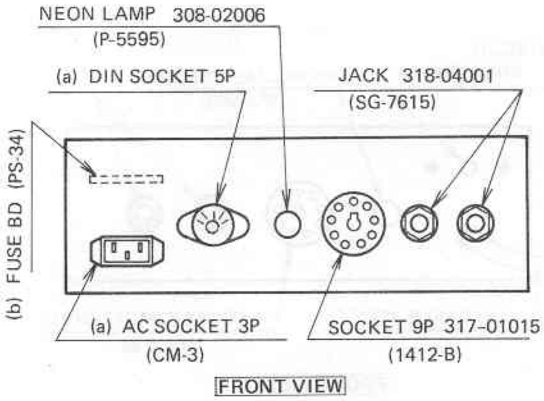
TOP VIEW

NOTE:

(a) Power Supply PWB Assy	224-15201	(PS-32)
(b) Fuse Boad Assy	224-15206	(PS-33)
(c) Transformer (220 ~ 240V)	307-01103	
(d) DIN Socket 5P	303-14001	
AC Socket 3P	303-09005	(CM-3)
AC Power Cable	439-01011 (to Main Amp.)	240V only
AC Power Cable	439-01009 (to Main Amp.)	220V only
(e) Power Supply Cord	439-01006	220V only
Power Supply Cord	439-01005	240V only

CHANGE: SERIAL NO. 01800 Up

MAIN AMP. ASSY 105-09231 (220V) 105-09232 (240V)

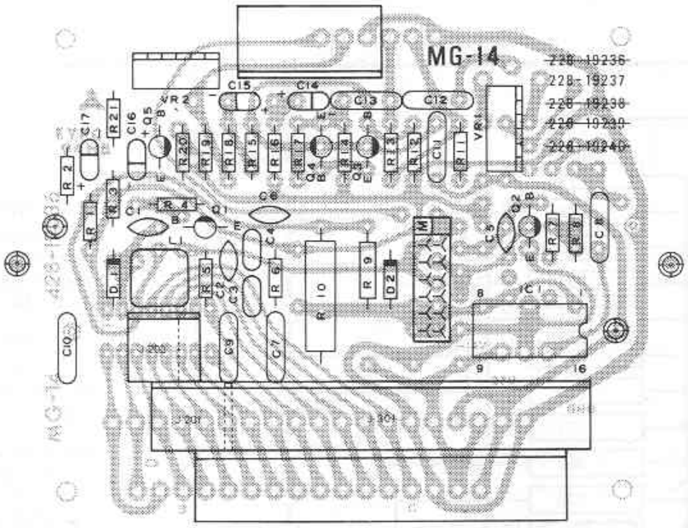


FRONT VIEW

NOTE:

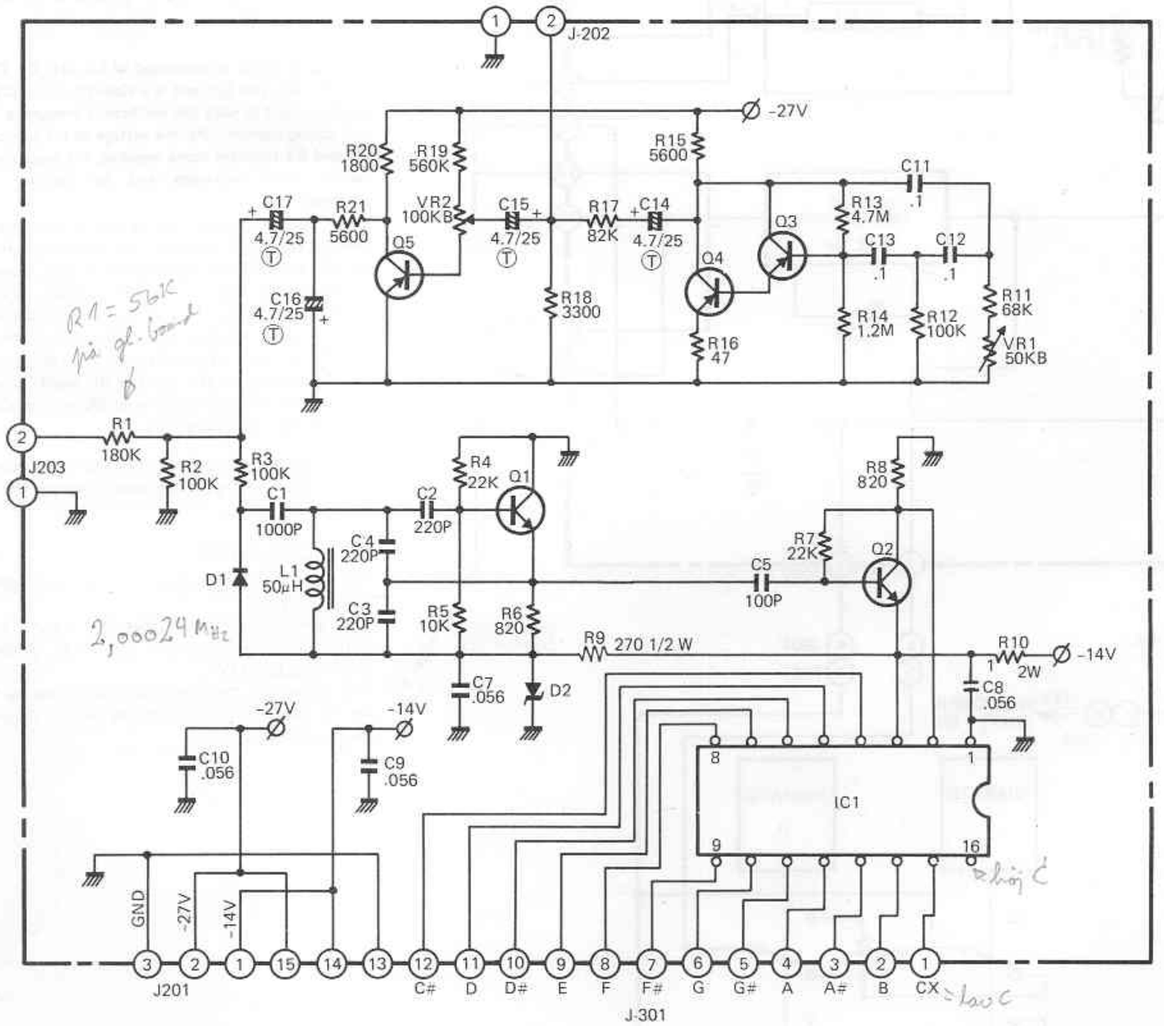
(a) DIN Socket 5P	303-14001	
AC Socket 3P	303-09005	(CM-3)
DIN Cord	440-01002	
(b) Fuse Board Assy	224-15211	(PS-34)
(c) Transformer (220V ~ 240V)	307-01104	

CHANGE: SERIAL NO. 01800 Up



Komponent og print tegning er vendt i forhold til hinanden!

This pcb layout is very faulty!



MDD GENERATOR BOARD

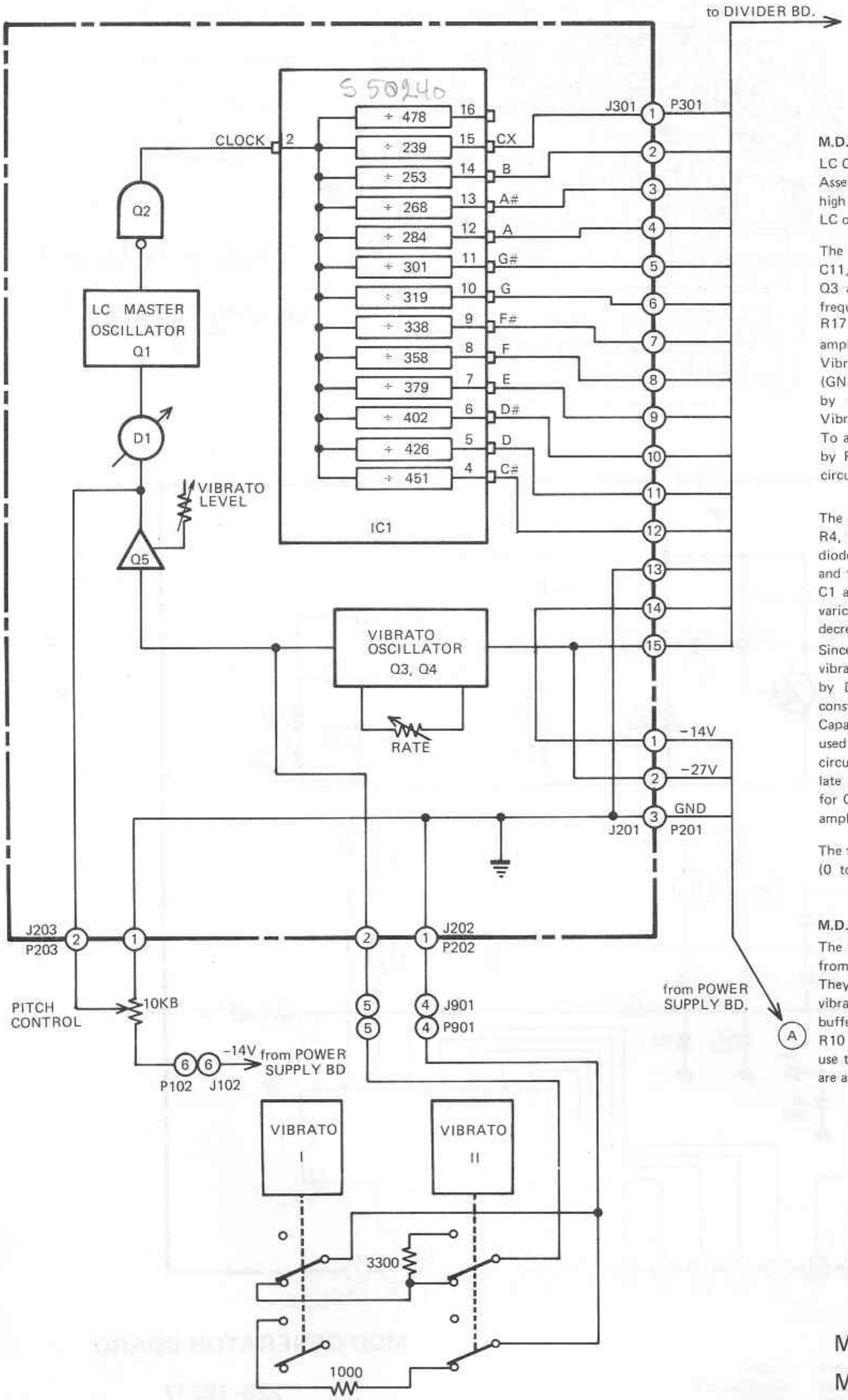
MG-14 228-19337 / 228-19237

NOTES:

1. IC1 — 319-01014 — S-50240
   - Q1, Q2 — 305-03063 — 2SC1675L or K
   - Q3 thru Q5 — 305-01008 — 2SA733Q
   - D1 — 306-05002 — ITT-310
   - D2 — 337-06022 — RD-10EB
   - C2, C3 — 311-19003 — THERMAL COMPENSATOR CAPAC.
   - C4 — 311-05005 — POLYSTYRENE FILM CAPAC.
2. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, ±5%, 1/4 WATT.
   ALL CAPACITORS ARE IN MICROFARADS.
3. (1) SYMBOL DENOTES NUMBERS IN TERMINALS.
   (T) SYMBOL DENOTES TANTALUME CAPAC.

FIGURE 3-7·3-8 (ADD-1)
MDD GENERATOR BOARD
MG-14A (228-19337)
SCHEMATIC DIAGRAM AND LAYOUT

3-8A·3-9A (ADD-1)



M.D.D. GENERATOR BOARD

LC Oscillator with vibrato.

Assembly 228-19237 inclues a vibrato oscillator, and a high frequency.

LC oscillator is used to drive the M.D.D. generator.

The vibrato oscillator is a phase shift type comprised of C11, C12, C13, R11, R12, R13, R14, R15, R16, VR1, Q3 and Q4. Pot VR1 is used to adjust the oscillator's frequency. The vibrato signal is coupled through C14, R17 and C15 to the base of transistor Q5, where it is amplified (its width being controlled by VR2).

Vibrato may be turned off by connecting J202-2 to J202-1 (GND), and may be reduced for "Vibrato I or Vibrato II" by connecting J202-2 through switch (Vibrato I and VibratoII) to J202-1.

To achieve a better sine wave the vibrato signals is filtered by R21 and C16, and is then coupled to the LC oscillator circuitry by C17.

The LC oscillator is comprised of L1, D1, C1, C2, C3, C4, R4, R5, R6, and Q1, and is a Colpitts type. D1, a varicap diode, is used to vary the oscillator's frequency for vibrato and tuning control: As the voltage at the junction of R3, C1 and D1 becomes more negative, the capacitance of the varicap diode, increases, and the oscillator frequency decreases.

Since the cathode of the varicap is normally (with no vibrato) at ground potential and the anode is held at -10V by D2 and R9, the capacitance of the varicap remains constant, and stability of the oscillator is maintained. Capacitor C1 is not part of the tank capacitance, but is used to isolate the D.C. bias on the varicap from the tank circuit. L1, with C3 and C4, and the varicap diode oscillate at 2.00024 M Hz. R4 and R5 supplt a bias voltage for Q1. The oscillator signal is couple through C5 to buffer amplifier Q2 which drives IC1.

The tuning is controlled at J203-2 from the varying voltage (0 to -14V) on the tuning potentiometer (10 K ohms).

M.D.D. GENERATOR

The top octave note is made from the clock signal, coming from Q2, by IC1.

They are supplied the negative D.C. voltage as that the vibrato oscillator is supplied -27V, L.C. oscillator -10V, buffer amp IC1-14V.

R10 is used for the high frequency by-pass by making to use the inductance of wire-wound resistor, and C7, C8, C9, are also for by-pass.

MDD GENERATOR BD

MG-14A 228-19237

FIGURE 3-7·3-8 (ADD-2)
MG-14A (228-19231)
BLOCK DIAGRAM OF M.D.D. GENERATOR BOARD AND THEORY

3-8A·3-9A (ADD-2)

CONVERSION PROCEDURE

[from EF-12A & MG-4D (MG-4B) to MG-14A]

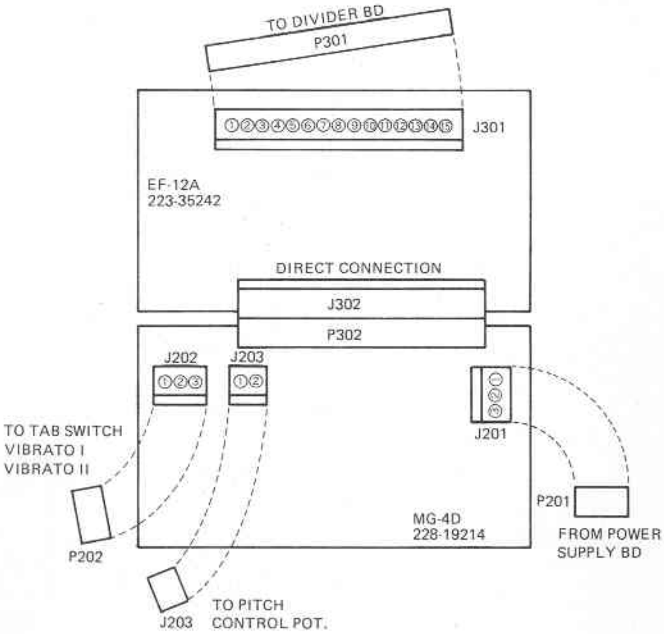
1. Change the Tab. Switch (Vibrato I, II) Circuit in the Lower L. H. End Block Assy. See (FIGURE 3)

2. Take off the blue wires from P901-6 to wire end (Soldered to Vibrato tab. switch) and from J901-6 to P202-3.

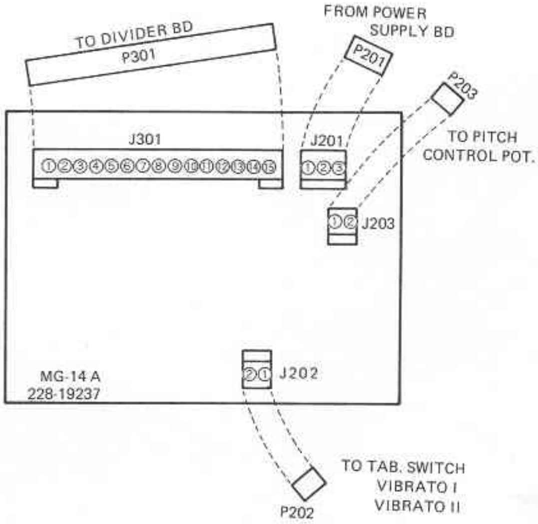
3. Locate P201 plug. Remove the wires from Pin 1 (-27V DC) and Pin 2 (-14V DC). And insert Pin 1 (with blue wire) into P201-2, Pin 2 (with green wire) into P201-1.

4. Connect P201, P202, P203 and P301 Plugs to MG-14A.

(FIGURE 1)
EF-12A (223-35242) & MG-4D (228-19214)
CONNECTION



(FIGURE 2)
MG-14A (228-19237)
CONNECTION



(FIGURE 3)
CHANGED TAB. SWITCH CIRCUIT
BACK SIDE VIEW

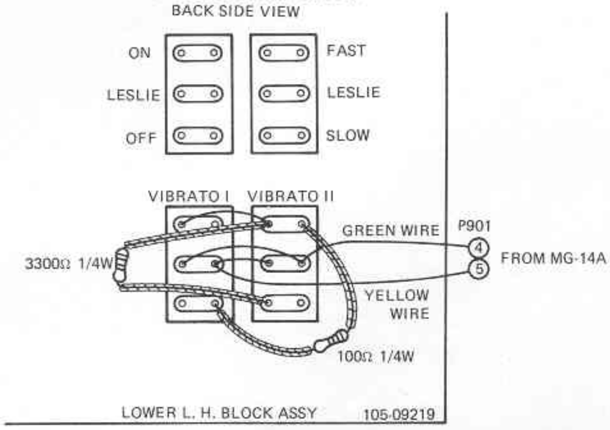
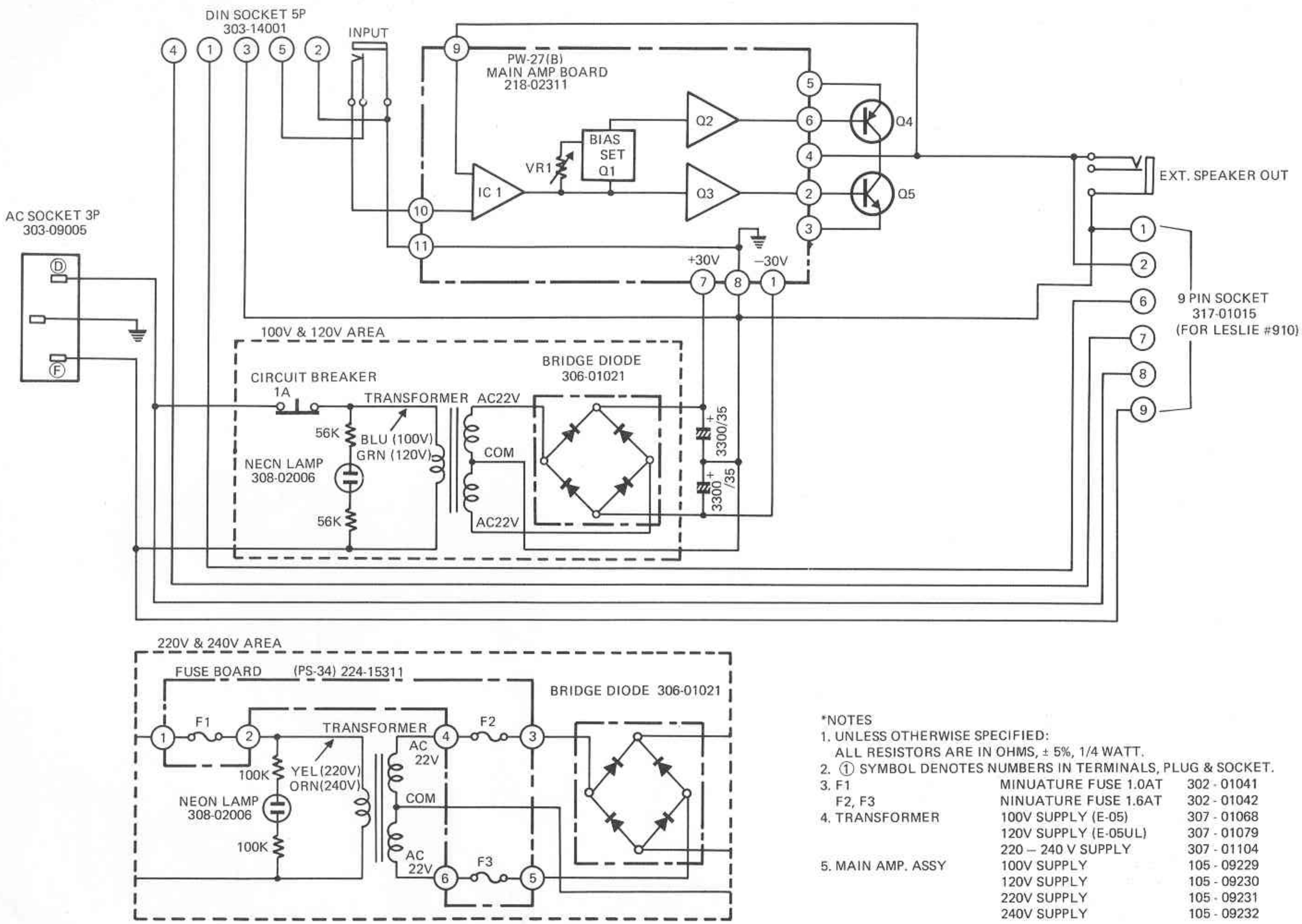


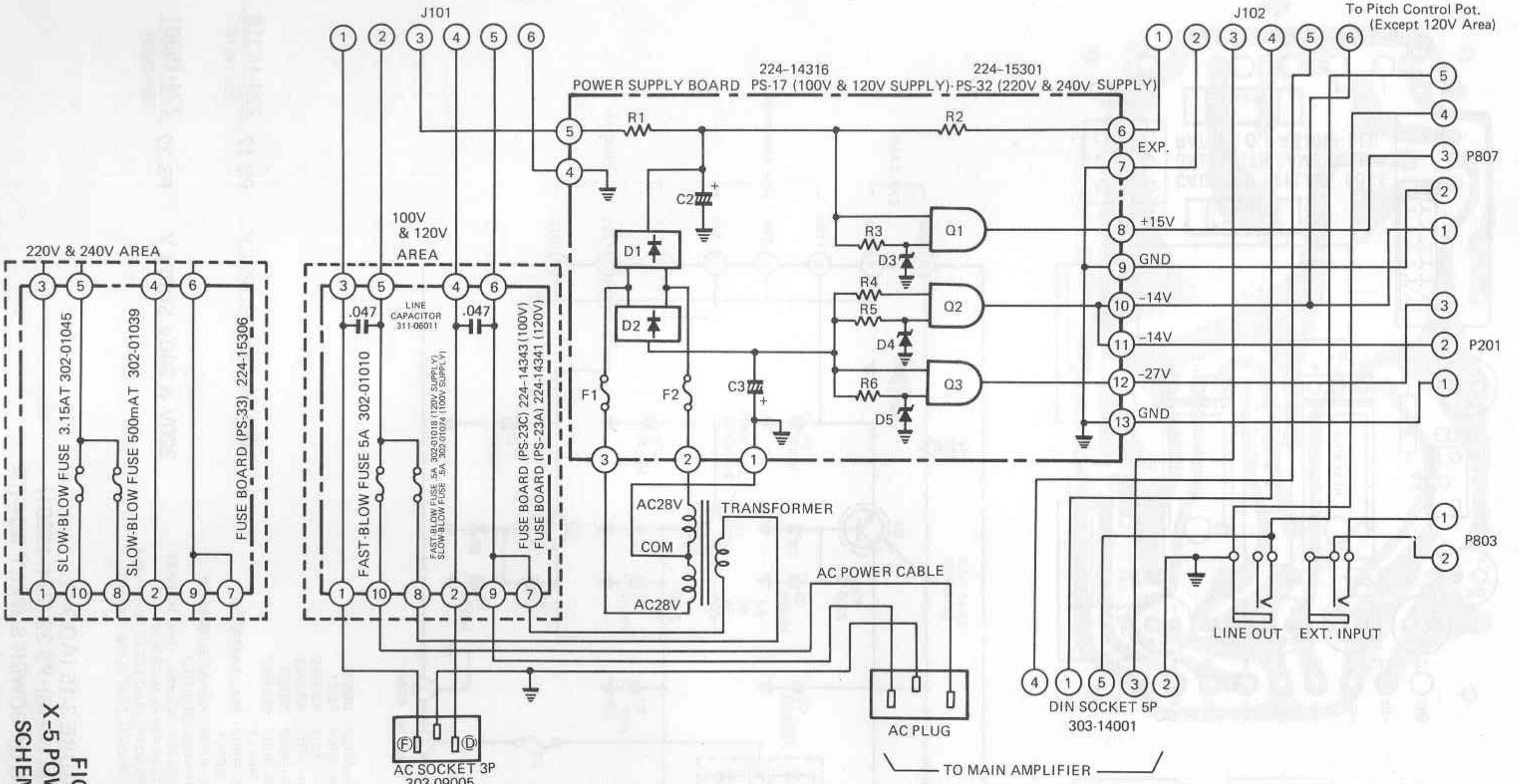
FIGURE 3-7·3-8 (ADD-3)
M.D.D. GENERATOR BOARD
MG-14A (228-19337)
CONVERSION PROCEDURE



*NOTES

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, ± 5%, 1/4 WATT.
2. ① SYMBOL DENOTES NUMBERS IN TERMINALS, PLUG & SOCKET.
3. F1 — MINUATURE FUSE 1.0AT — 302 - 01041
   F2, F3 — NINUATURE FUSE 1.6AT — 302 - 01042
4. TRANSFORMER — 100V SUPPLY (E-05) — 307 - 01068
   120V SUPPLY (E-05UL) — 307 - 01079
   220 – 240 V SUPPLY — 307 - 01104
5. MAIN AMP. ASSY — 100V SUPPLY — 105 - 09229
   120V SUPPLY — 105 - 09230
   220V SUPPLY — 105 - 09231
   240V SUPPLY — 105 - 09232

FIGURE 3-12 (ADD-1)
X-5 MAIN AMPLIFIER (105-09329-32)
SCHEMATIC OF MAIN AMPLIFIER UNIT 3-13A (ADD-1)

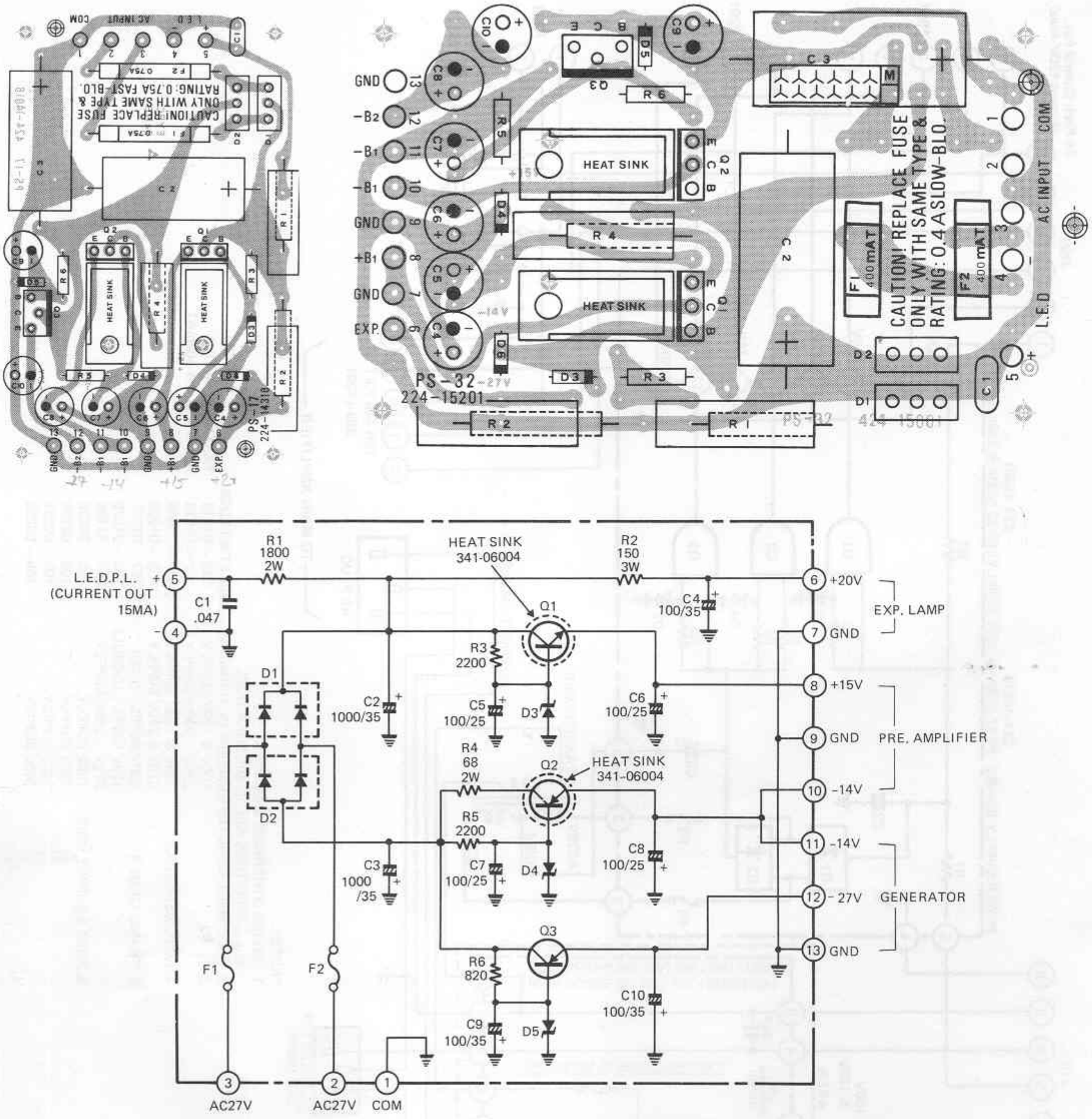


*NOTES

1. UNLESS OTHERWISE SPECIFIED: ALL CAPACITORS ARE IN MICROFARADS.
2. ① SYMBOL DENOTES NUMBERS IN TERMINALS, SOCKET & PLUGS.

3. F1, F2	100V & 120V SUPPLY	302 – 01012	FAST – BLOW .75A
	220V – 240V SUPPLY	302 – 01073	SLOW – BLOW 400mAT
4. AC POWER CABLE	100V & 120V SUPPLY	438 – 01008	
	220V & 240V SUPPLY	438 – 01009	
5. TRANSFORMER	100V SUPPLY (E-06)	307 – 01077	
	120V SUPPLY (E-06UL)	307 – 01078	
	220V – 240V SUPPLY	307 – 01103	
6. POWER SUPPLY UNIT	100V SUPPLY	105 – 09225	
	120V SUPPLY	105 – 09226	
	220V SUPPLY	105 – 09227	
	240V SUPPLY	105 – 09228	

FIGURE 3-14 (ADD-1)
X-5 POWER SUPPLY (105-09325-8)
SCHEMATIC OF POWER SUPPLY
3-15A (ADD-1)



*NOTES

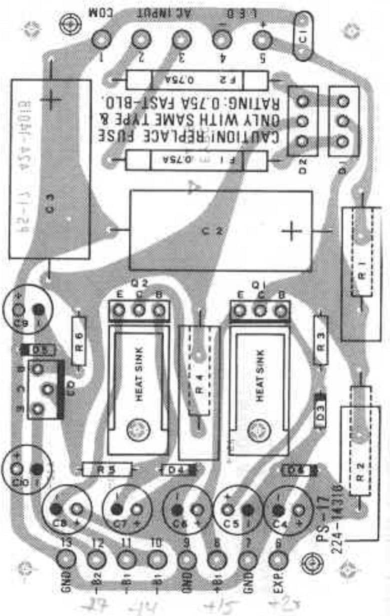
1.

D1	306–01023	1B2C1	
D2	306–01024	1B2Z1	
D3, D4	337–06013	RD-15EC	
D5	337–06015	RD-27EB	
Q1	305–04005	2SD234	
Q2, Q3	305–01013	2SA490Y	

2. 100V & 120V SUPPLY
   F1, F2 302–01012 .75A FAST-BLOW
   220V & 240V SUPPLY
   F1, F2 302–01073 400mAT SLOW-BLOW
3. UNLESS OTHERWISE SPECIFIED
   ALL RESISTORS ARE IN OHMS, ± 10%, 1/2 WATT.
   ALL CAPACITORS ARE IN MICROFARADS.
4. (1) SYMBOL DENOTES NUMBERS IN TERMINALS.
   (T) SYMBOL DENOTES TANTALUME CAPAC.

100V & 120V SUPPLY	PS-17	224-14316 / 224-14216
220V & 240V SUPPLY	PS-32	224-15301 / 224-15201

FIGURE 3-15 (ADD-1)
PS-17 (224-14316)·PS-32 (224-15301)
SCHEMATIC OF POWER SUPPLY BOARD
AND LAYOUT



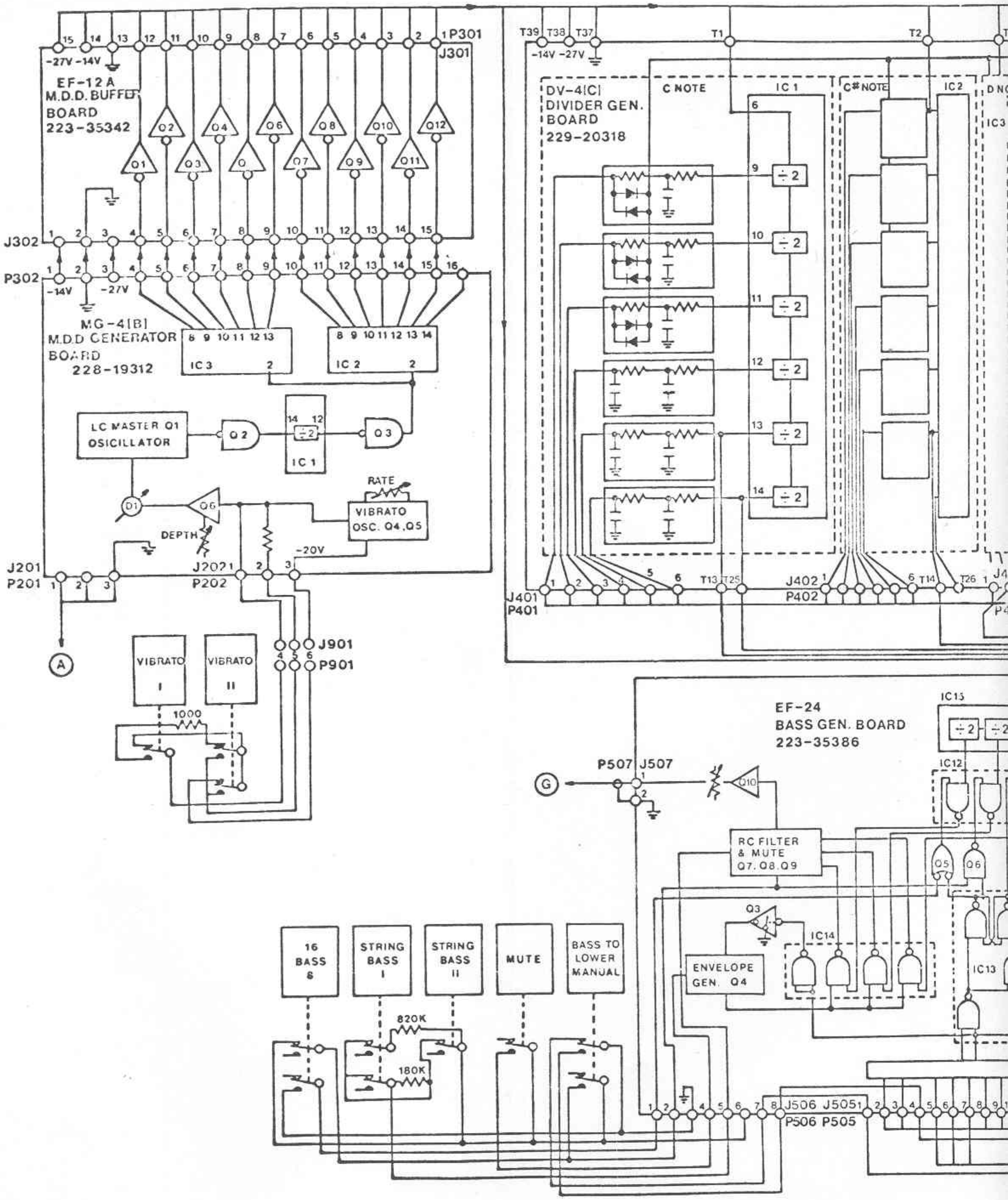
COM
AC INPUT
LED
CAUTION! REPLACE FUSE ONLY WITH SAME TYPE & RATING: 0.75A FAST-BLO.
F 1 0.75A
F 2 0.75A
C 1
C 2
C 3
D 1
D 2
D 3
D 4
D 5
D 6
Q 1
Q 2
E C B
HEAT SINK
R 1
R 2
R 3
R 4
R 5
R 6
C 4
C 5
C 6
C 7
C 8
C 9
C 10
PS-17
224-14316
GND
-B2
-B1
+B1
EXP

APPENDIX

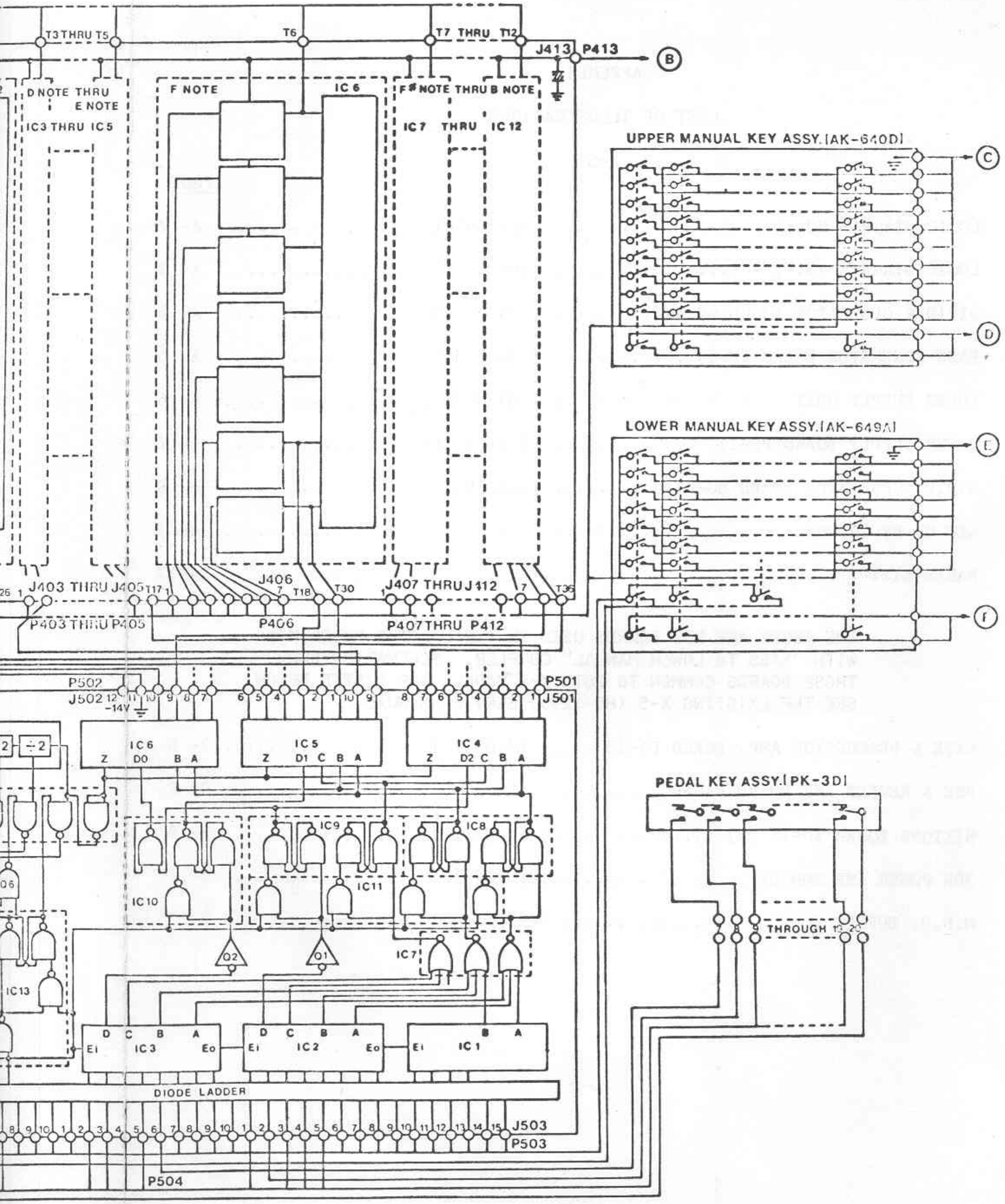
LIST OF ILLUSTRATIONS

X-5

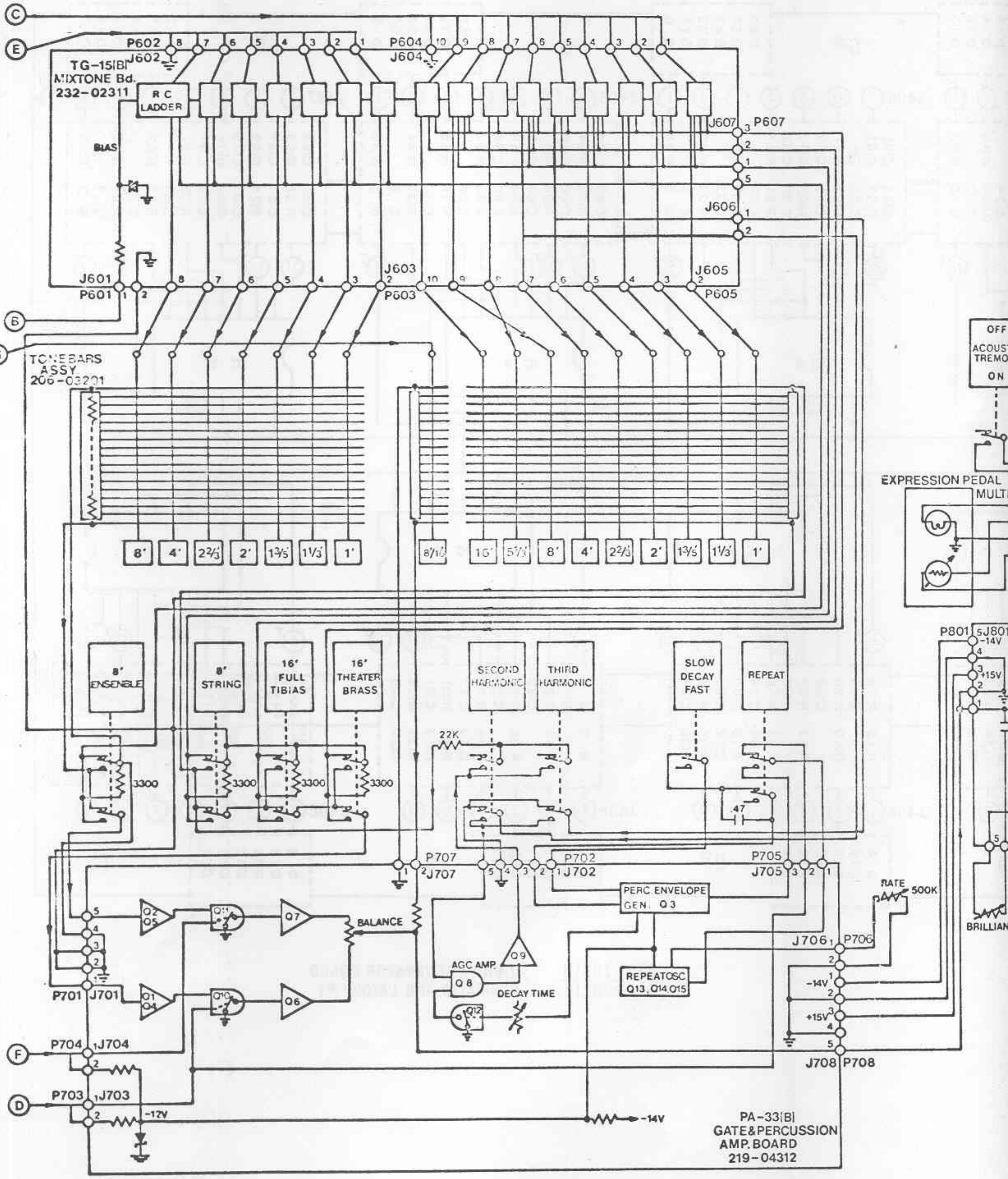
THE ABOVE ARE NEW BOARDS USED IN THE UPDATED MODEL X-5 WITH "BASS TO LOWER MANUAL" COUPLER. SCHEMATICS FOR THOSE BOARDS COMMON TO BOTH X-5 MODELS ARE LISTED BELOW. SEE THE EXISTING X-5 (HO-1296) SERVICE MANUAL.



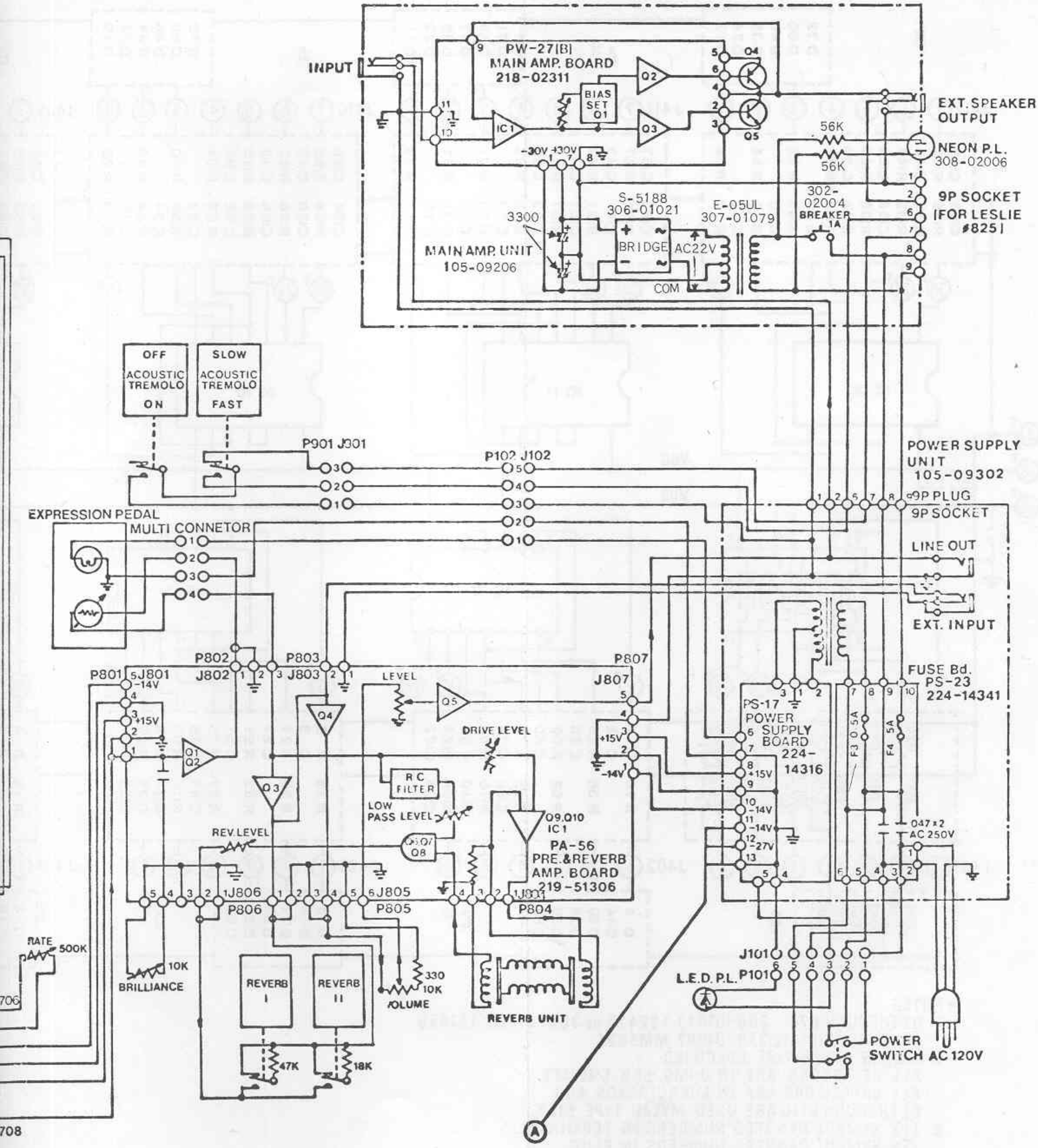
LOGIC DIAGRAM NO. 1
105-09301



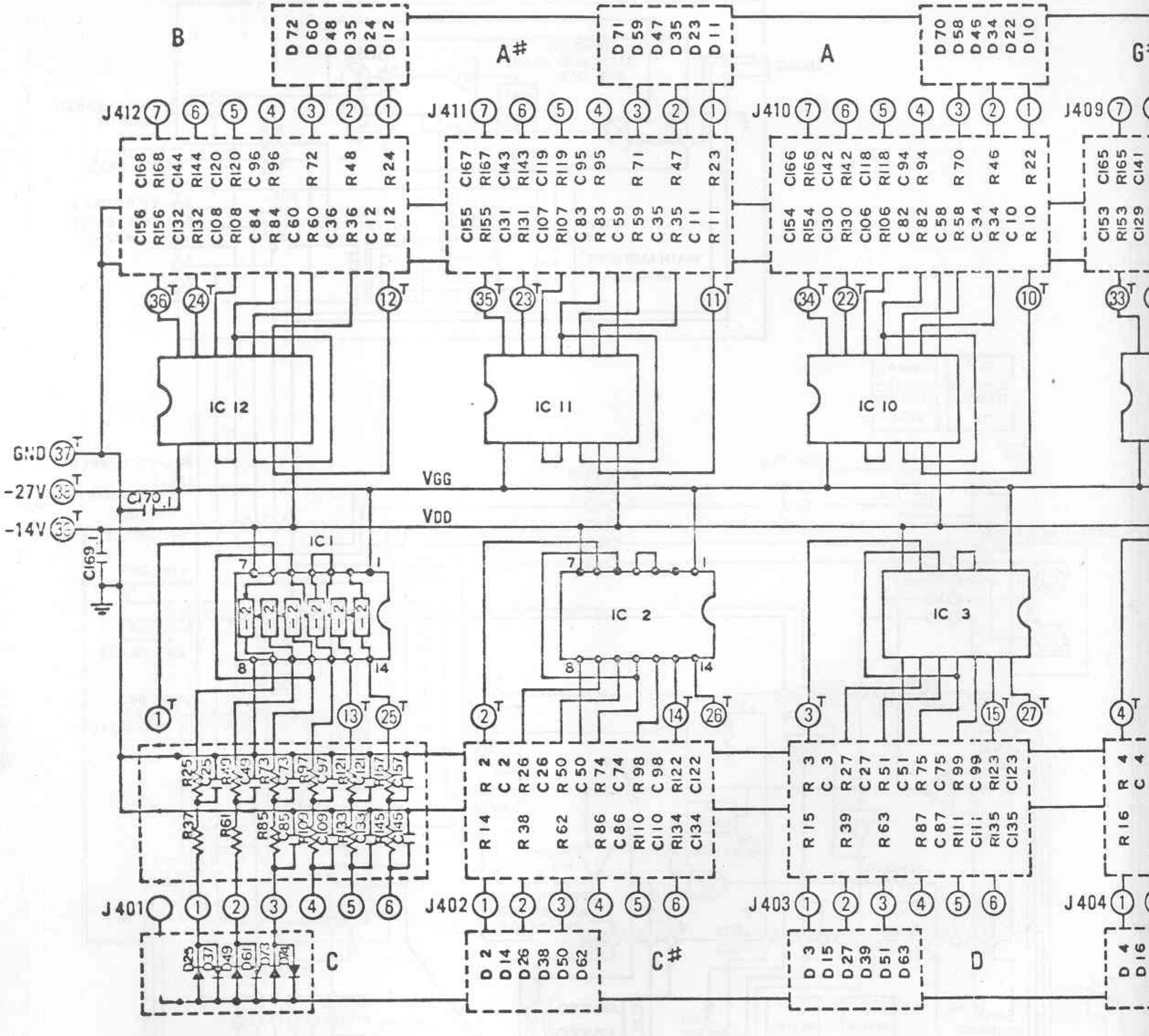
T3 THRU T5
T6
T7 THRU T12
J413
P413
B
D NOTE THRU E NOTE
IC3 THRU IC5
F NOTE
IC 6
F# NOTE THRU B NOTE
IC7 THRU IC 12
UPPER MANUAL KEY ASSY. (AK-640D)
C
D
LOWER MANUAL KEY ASSY. (AK-649A)
E
F
J403 THRU J405
J406
J407 THRU J412
P403 THRU P405
P406
P407 THRU P412
P502
J502
-14V
P501
J501
IC 6
IC 5
IC 4
PEDAL KEY ASSY. (PK-3D)
THROUGH
IC9
IC8
IC10
IC11
IC7
Q2
Q1
IC13
IC 3
IC 2
IC 1
DIODE LADDER
J503
P503
P504



C
E
P602
J602
TG-15(B)
MIXTONE Bd.
232-02311
R C
LADDER
P604
J604
J607
P607
J606
BIAS
J601
P601
J603
P603
J605
P605
B
G
TONE BARS
ASSY
206-03201
8'
4'
2 2/3'
2'
1 3/5'
1 1/3'
1'
8'/16'
16'
5 1/3'
8'
4'
2 2/3'
2'
1 3/5'
1 1/3'
1'
OFF
ACOUST
TREMO
ON
EXPRESSION PEDAL
MULTI
P801
J801
-14V
+15V
8'
ENSEMBLE
8'
STRING
16'
FULL
TIBIAS
16'
THEATER
BRASS
SECOND
HARMONIC
THIRD
HARMONIC
SLOW
DECAY
FAST
REPEAT
22K
3300
3300
3300
3300
.47
P707
J707
P702
J702
P705
J705
RATE
500K
BRILLIAN
PERC. ENVELOPE
GEN. Q3
BALANCE
Q2
Q5
Q11
Q7
Q1
Q4
Q10
Q6
AGC AMP.
Q8
Q9
Q12
DECAY TIME
REPEAT OSC
Q13, Q14, Q15
J706
P706
-14V
+15V
J708
P708
P701
J701
F
P704
J704
D
P703
J703
-12V
-14V
PA-33(B)
GATE&PERCUSSION
AMP. BOARD
219-04312

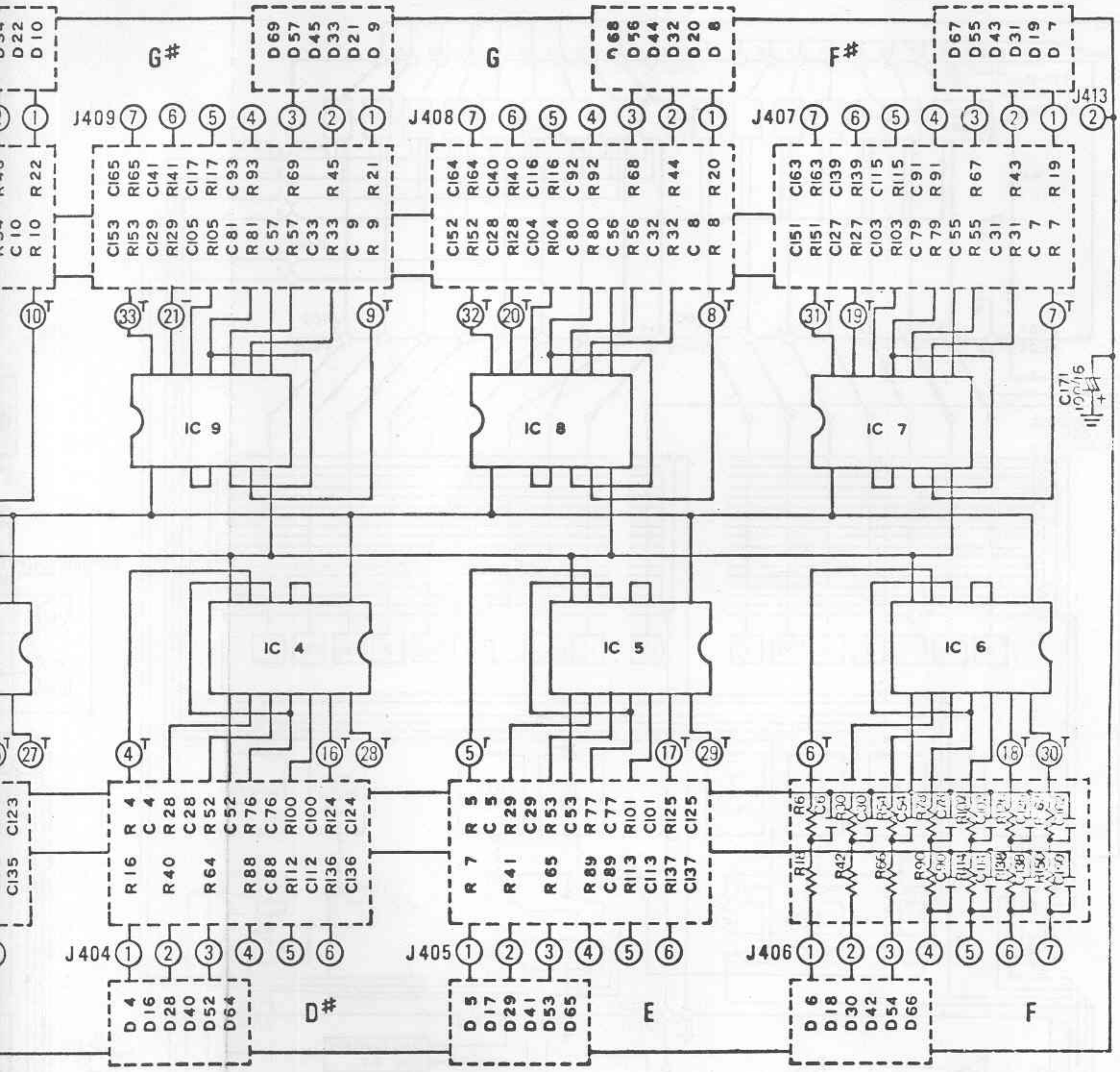


LOGIC DIAGRAM NO. 2
105-09301

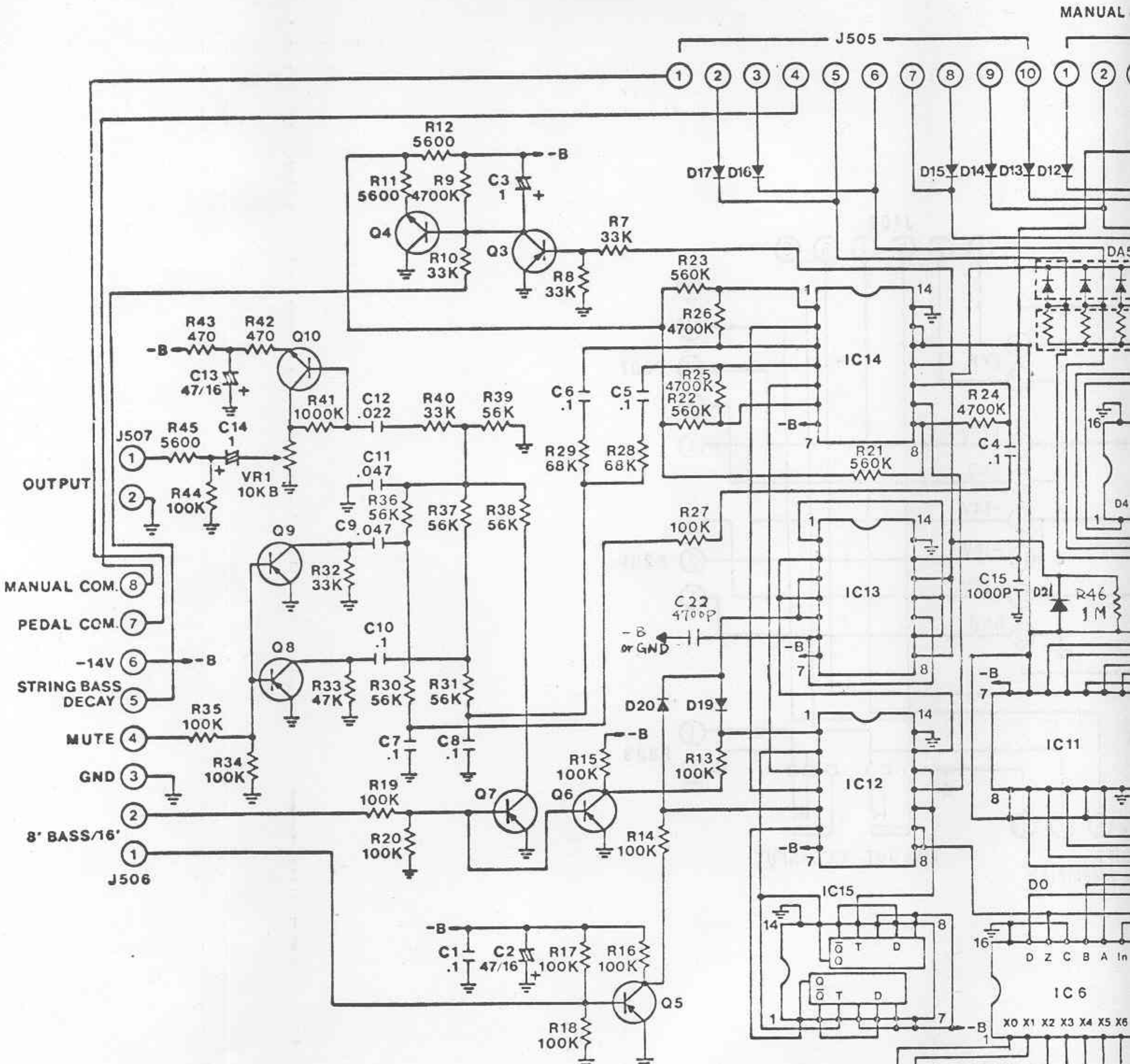


- NOTES
  1. D2 THROUGH D74 306-01017 1S2473 or 306-01005 1S1555
     IC1 THROUGH IC12, 319-01007 MM5824
  2. UNLESS OTHERWISE SPECIFIED:
     ALL RESISTORS ARE IN OHMS, ±5%, 1/4WATT.
     ALL CAPACITORS ARE IN MICROFARADS, AND
     C1 THROUGH C170 ARE USED MYLAR TYPE, ±10%.
  3. (1)T SYMBOL DENOTES NUMBERS IN TERMINAL.
     (1) SYMBOL DENOTES NUMBERS IN PLUG.
  4. C NOTE THROUGH E NOTE ARE 6STAGES, AND
     F NOTE THROUGH B NOTE ARE 7STAGES.
     CURCUITS OF EACH NOTES ARE ALL SIMILARLY.

DIVIDER GENERATOR BOARD
DV-4(C) 229-20318



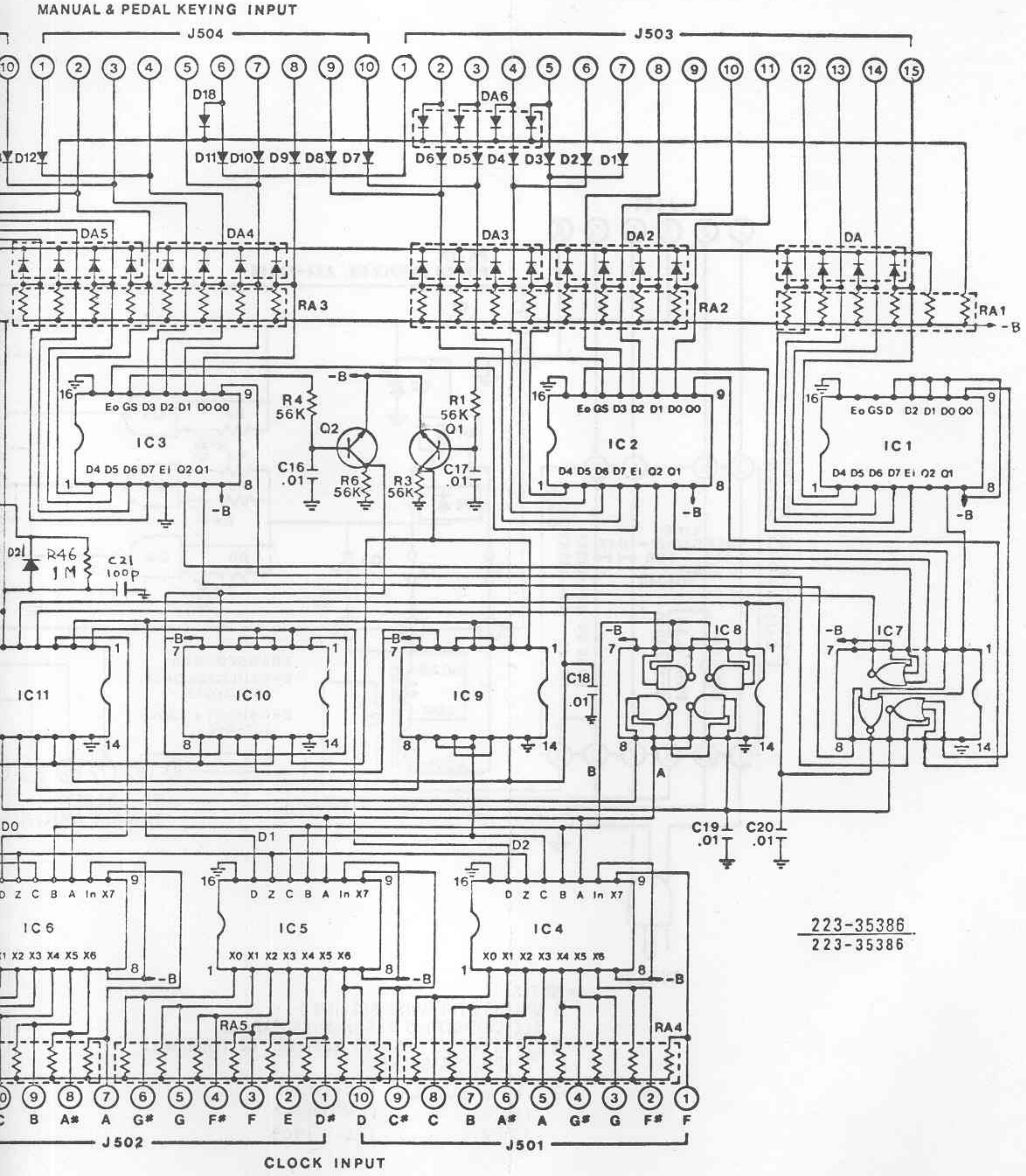
229-20318 / 229-20218 DIVIDER GENERATOR BOARD SCHMATIC AND LAYOUT #1



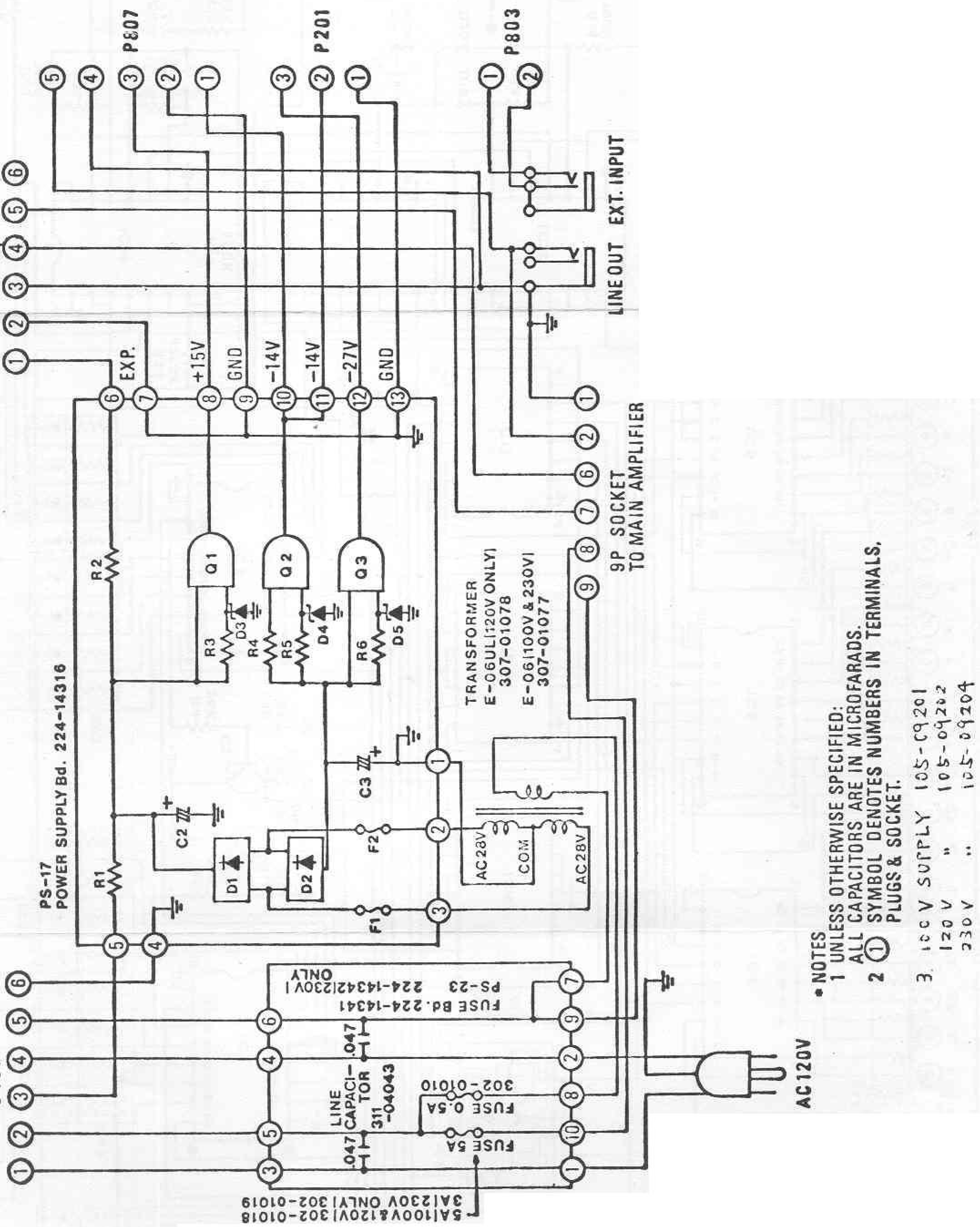
·NOTES

1 D1 THROUGH D26 — 306-01017 1S2473
DA1 THROUGH DA6 — 306-01027 DAN-4 (DIODE ARRAY)
RA1 THROUGH RA6 — 320-97004 8-33u (RESISTOR ARRAY)
Q3,Q5 THROUGH Q9 — 305-01008 2SA733Q
Q1,Q2 Q4 — 305-03040 2SC945Q
Q10 — 305-03023 2SC1000GR
IC1 THROUGH IC3 — 319-09001 MC14532CP (8 BIT PRIORITY ENCODER)
IC4 THROUGH IC6 — 319-10001 MC14512CP (8 Ch. DATA SELECTOR)
IC7 — 319-06007 MC14025CP (TRIPLE NOR GATE)
IC8 THROUGH IC14 — 319-06006 MC14011CP (QUAD NAND GATE)
IC15 — 319-03004 MC14013CP (DUAL D FLIP FLOP)

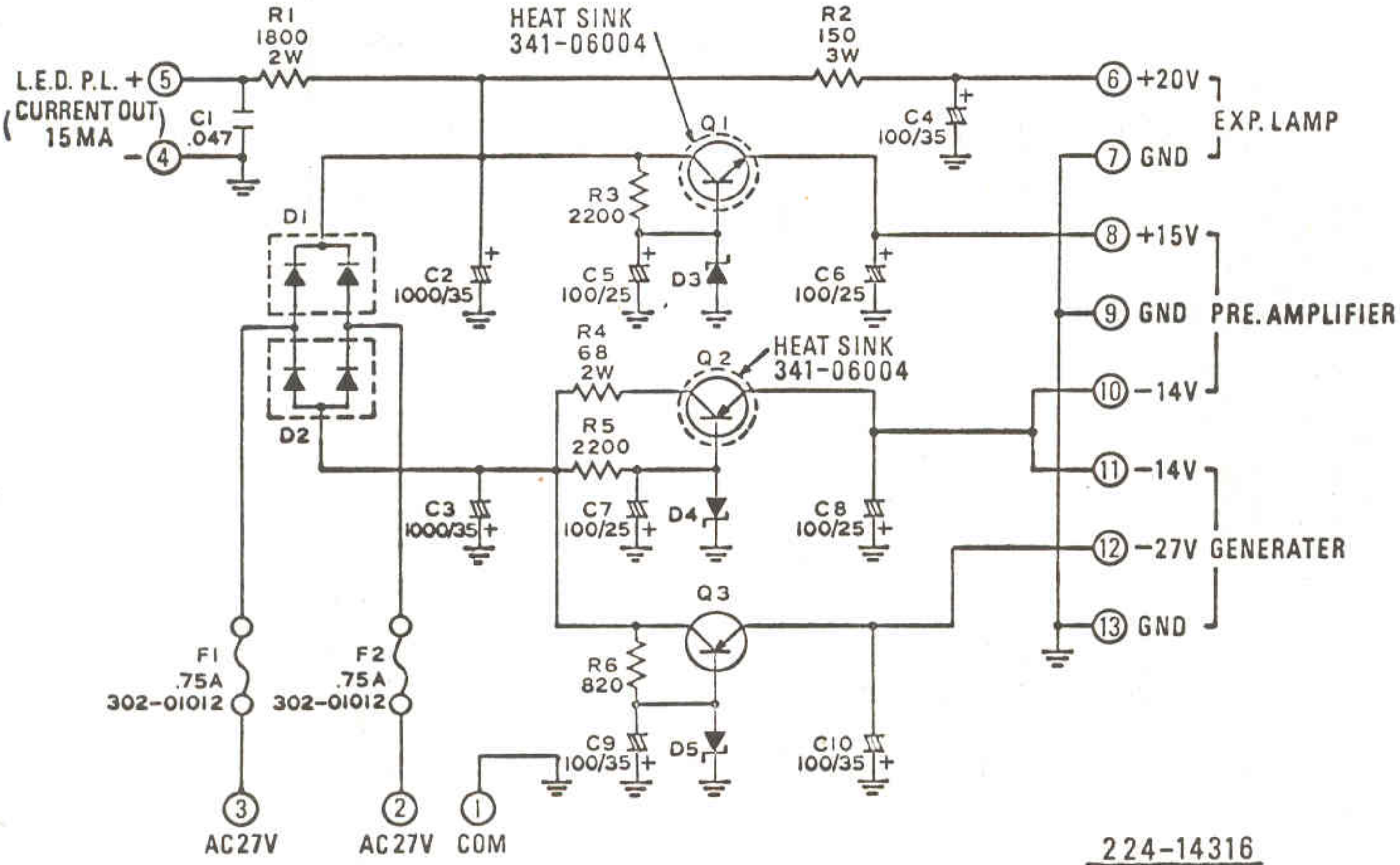
2 UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS, ±5%, 1/4 WATT.
ALL CAPACITORS ARE IN MICROFARADS.
C3 AND C14 ARE USED WITH TANTALUM, ±10%.
(1) SYMBOL DENOTES NUMBERS IN PLUG.



BASS GENERATOR BOARD
EF-24 223-35386



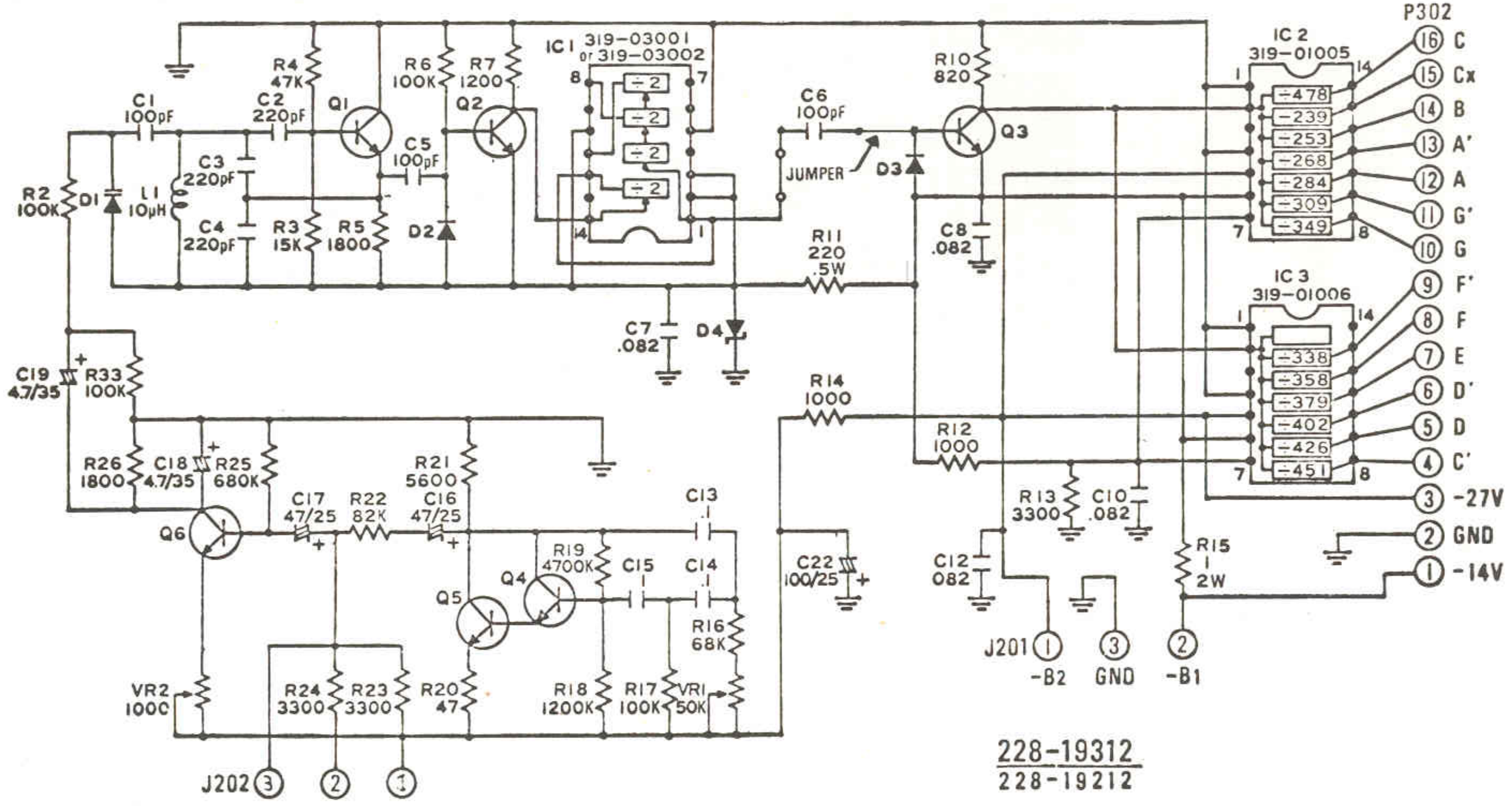
Power Supply Unit
105-09302



224-14316
224-14216

* NOTES
1 D1 306-01023 1B2C1 ~~D6 337-06017 RD20EB~~
D2 306-01024 1B2Z1
D3,D4 337-06013 RD15EC
D5 337-06015 RD27EB
Q1 305-04005 2SD234
Q2,Q3 305-01013 2SA490Y
2 UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS, ±10%, 1/2 WATT.
ALL CAPACITORS ARE IN MICROFARADS.
3 ① SYMBOL DENOTS NUMBERS IN TERMINALS.

POWER SUPPLY BOARD
PS-17 224-14216



228-19312
228-19212

•NOTES

1 D1 306-05001 1S2206

D2,D3 306-01017 1S2473

D4 337-06014 RD-5.6EB

~~Q1 305-03014 2SC373~~

Q4 ~~Q2~~ THROUGH Q6 305-03040 2SC945Q

Q1 THROUGH Q3 305-03063 2SC1675

2 UNLESS OTHERWISE SPECIFIED:

ALL RESISTORS ARE IN OHMS.±5%.1/4WATT.

ALL CAPACITORS ARE IN MICROFARADS.

3 (1) SYMBOL DENOTES NUMBERS IN PLUG.

M.D.D. GENERATOR BOARD

MG-4 (B) 228-19212

TEST AND ADJUSTMENT PROCEDURES
X-5 (18150)

WITH BASS TO LOWER MANUAL COUPLER

Step	Test & Test Point	Depress Tab, or Extend Tone Bar	Play Keys	Adjust	Oscilloscope or Other Ind	Fig.
	Preperations					
1 (a)	Connect Pedal Connector, Main Amp. Connector					
(b)	Connect Ext. Sp. Out. of Main Amp. as Fig. 1 And Power Switch is to "ON".					1
(c)	All Tab.s are to "OFF". All Control Knobs are to "MAX.".					
	Power Supply					
2 (a)	Indicator Light			Note: Confirm Light "ON".		
(b)	Terminals on PS-17 Board			TERM. 12 (BLU) TERM. 10 (GRN) TERM. 8 (ORN) TERM. 7 (BRN) Note: Confirm AC Line and GND are "OPEN".	-25 TO -27.5V -13 TO -15V +14 TO +15.5V +18 TO +21V	
	Tune & Scale					
3 (a)	Across Speaker	Upper Man. Tone/ Bar 8' to 8	Middle Key A on Up. Man.	Coil L1 on MG-4(B) Bd.	440 Hz	
(b)		All Foot & All Sounds	All Keys	Note: 3dB MIN. (two keys next to) Except Scale Repeated.		
	Output Level					
4 (a)	Across Speaker	Up. Man. 8' Tone/ Bar to 8 Low. Man. 8' Tone /Bar to 8	Middle Key C on Upper & Lower Man.	Pot. VR1 on PA-33(B) Bd.	Conform Upper Man. & Lower Man. is same level.	
(b)		Ensemble Tab. to "ON". String Tab. to ON Full Tibias Tab. Theater Brass Tab.	Mid. C, E, & G on Lower Manual Mid. C, E, & G on Upper Manual	Pot. VR1 on PA-56 Bd.	1.2v rms. 1.5v ±0.3v rms. 1.5v ±0.3v rms. 1.8v ±0.4v rms.	
(c)		Upper Man. Tone Bar 16' Tone/Bar 5-1/3' " 8' " 4' " 2-2/3' " 2' " 1-3/5' " 1-1/3' " 1' "		Note: All levels are ±20% MAX.	1.4v rms. 0.9v rms. 1.9v rms. 1.0v rms. 0.75v rms. 0.75v rms. 0.75v rms. 0.75v rms. 0.8v rms.	

STEP	TEST & TEST POINT	DEPRESS TAB, OR EXTEND TONE BAR	PLAY KEYS	ADJUST	OSCILLOSCOPE OR OTHER IND.	FIG.
(c)		Lower Man.Tone Bar				
		8'Tone/Bar			1.0v rms.	
		4'Tone/Bar			0.9v rms.	
		2-2/3'Tone/Bar			0.75v rms.	
		2'Tone/Bar			0.75v rms.	
		1-3/5'Tone/Bar			0.75v rms.	
		1-1/3'Tone/Bar			0.75v rms.	
		1'Tone/Bar			0.8v rms.	
	<u>Bass</u>					
5(a)	1 Bass Level across Speaker	Bass ToneBar to 8 Bass Tab. to 8'	Pedal Key C of high note	Pot.VR1 on EF-24	1.0v rms.	
			Pedal Key G		1.4v±0.5v rms.	
			Pedal Key C of Low Note		1.8v±0.5v rms.	
		Bass ToneBar to 8 Bass Tab to 8' Mute Tab to "ON"	Pedal Key C of High Note		0.92v±0.5v rms.	
(b)	II Bass Decay Time across Speaker	String Bass Tab to "OFF"	Pedal Key C of High Note	NOTE:All decay Time are +15% MAX	150 msec.	
		String Bass Tab I to "ON"			400 msec.	
		String Bass Tab II to "ON"			800 msec.	
		String Bass Tab I & II to "ON"			1500 msec.	
(c)	Manual Bass Across Speaker	Bass to lower Tab to "ON"	Lower Man. Key lowest F to C of 20 notes.	NOTE: 1. String Bass Tab & Mute Tab are achieved except Bass tab. 2. Manual Bass note is Low Note Select, and 16'only.		
	<u>Extent of Expression Pedal</u>					
6(a)	Across Speaker	Full Tibias Tab to "ON"	Mid.Key C. on Up.Man.	Level is at -20dB~ -24dB When Exp. Pedal MAX to MIN. (Level is 0dB at Exp.Pedal MAX.)		
	<u>Noise Level</u>					
7(a)	Across Speaker	All tabs to "ON"(Except Reverb Tab & Mute Tab.) All ToneBar to 8			2mv rms MAX.	
		All Tabs to "OFF"	Mid.Key C. on Up.Man. & Low. Man.		4 mv rms. MAX.	
		All ToneBar to 0 (OFF), and Percussion Tabs to "ON"			No. noise occurs	

NOTE: During Test Procedure the following must be maintained unless otherwise stated.
a. All Control Knobs & Expression Pedal at Maximum.
b. All Tabs and all Tone Bars in the off position.

Step	Test & Test Point	Depress Tab, or Extend Tone Bar	Play Keys	Adjust	Oscilloscope or Other Ind	Fig.
	Brilliance & Freq. Response					
8 (a)	Across Speaker	Upper Man. Tone/ Bar 4' to 8	Upper Man. Key F of Lowest Note Up. Man. Key F of Highest Note	Point of Brill. Volume Max. MIN. 0dB (Set to Volume Control) −2dB −4dB −13dB −20dB		
	Percussion					
9 (a)	Across Speaker	Second Harmonic Tab. to "ON" Decay Tab. to "Slow"	Middle Key C on Upper Manual	Pot VR2 on PA-33(B) Board	t; 1500 msec.	3
		Next Decay Tab. to "Fast"			t; 90 msec.	
		Third Harmonic Tab. as in step to do Sec. Harm. Tab.	Check as same to Second Harmonic.			
	Repeat					
(b)	Across Speaker	Second Harmonic Tab. to "ON" Decay Tab. to "Slow"	Middle Key C on Upper Manual	Reit Volume to "Slow"	t; 500+100 msec.	4
		Repeat Tab. to "ON", and Decay Tab. to "Fast"		Reit to Slow (MIN.)	Reit; 13+3 times/ 10 sec.	
				Reit to Fast (MAX.)	Reit; 70+7 msec.	
	Vibrato					
10 (a)	Test Point R-26 on MG-4(B) Bd.	Vibrato I & II Tab. to "ON"		Pot. VR1 on MG-4(B) Board Pot. VR2 on MG-4(B) Board	t; 152 msec. (6.8Hz) 8v p-p	5 6
		Vibrato I & II Tab. to "OFF"			Ov	
		Vibrato I Tab. to "ON"			2v p-p	7
		Vibrato II Tab. to "ON"			4v p-p	
	Reverb					
11 (a)	Test Point R-43 & J4 on PA-56 Board	Low. Man. Tone Bar 8' to 8	Middle Key C on Lower Manual	Pot. VR2 on PA-56 Board	2v p-p	7
(b)	Test Point Reverb Tab. & Ear	Reverb I & II Tab. to "ON"	Mid. Key C E & G on Low. Man.	Pot. VR4 on PA-56 Board	About 70 mv & Decay Time: 2.5-3 sec.	8
(c)	Balance Ear			Pot. VR3 on PA-56 Board	Same Level on Reverb "OFF" from I & II to "ON"	

Step	Test & Test Point	Depress Tab. or Extend Tone Bar	Play Keys	Adjust	Oscilloscope or Other Ind	Fig.
12 (a)	**Other Operation**					
12 (a)	Leslie Socket; Pin 7, Pon 6, & 1	Leslie ON/OFF to "ON" Leslie Slow/Fast to "Fast" Leslie ON/OFF to "OFF"	Note: That Pin 6 is grounded (to Pin 1) and that Pin 7 is removed from ground (Pin 1). If Tab. is returned to Slow, Pin 7 will be grounded. Pin 6 and Pin 7 are removed from ground (Pin 1).			9
13 (a)	Ear	Ensemble Tab. to "ON" Lower Man. Tone/ Bar sets to: 8666444	Note: Same Tone as Tone Bar Setting.			
		String Tab. to "ON" Upper Man. Tone/ Bar sets to: 008888666	Same Tone as Tone Bar Setting.			
		Full Tibias Tab. to "ON" – do –, sets 806808006	– ditto –			
		Theater Brass Tab. to "ON" – do –, sets 848868666	– ditto –			

14 Test of Mechanism Operation

a) Confirm that Tone Bars are easy to operate, and that one Tone Bar doesn't disturb other Tone Bar operation, and that Mark 8 is visible.

b) Confirm that Keyboards are operational.

c) Confirm that Expression Pedal is normal to operate and to stop at will.

d) Confirm that position of Knob Mark is normal.

e) Confirm that Pedal Keys are normal to operate.

f) Confirm that Tab.s are normal to operate.

15 Assembly

a) Confirm that Cabinet can be put on the Leg.

b) Confirm that Pedal Unit can be smoothly inserted.

c) Confirm that Knob Bolts can be set normally.

Step	Test & Test Point	Adjust	Oscilloscope or Other Indication	Fig.
	Main Amplifier			
16 (a)	Preparations Across Ext. Sp. Out	Connection as Fig. 10, 11		10
(b)	Test Point R26 on PW-27(B) Board	Pot. VR1 on PW-27(B) Board Note: Set VR1 to turn left, and turn right, Stop at 10mV Point.	Sot 10mV, and about afteral Minute 35mV + 5mV	11
(c)	Across Ext. Sp. Out	Input: 0.3V rms. (1000Hz)	Output: 16V Note: Confirm that Output Wave Form is normal or not.	10
(d)	Test Point GND . . . . + Vcc GND . . . . + Vcc		+ 30V ~ + 35V DC −30V ~ −35V DC	

FIGURE

Fig. 1

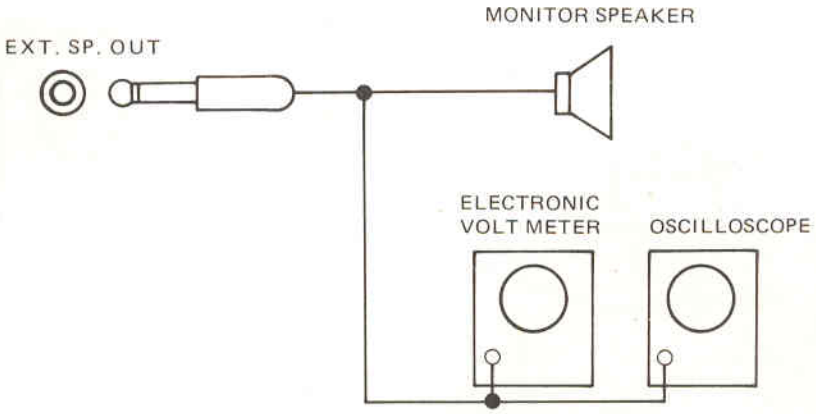


Fig. 2

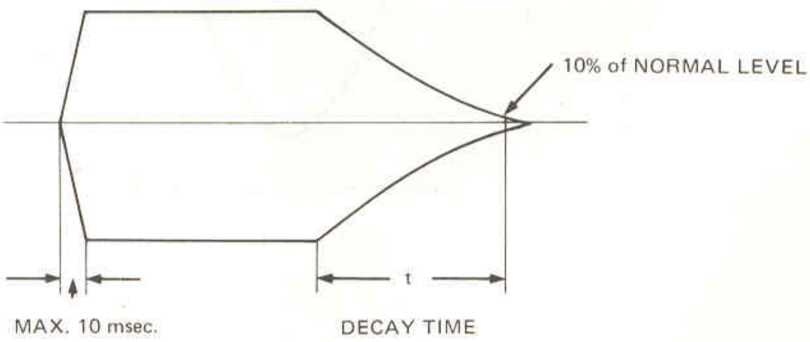


Fig. 3

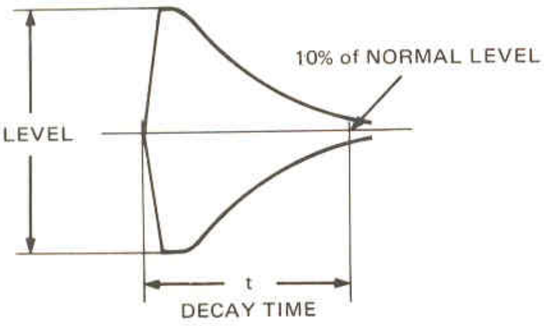


Fig. 4

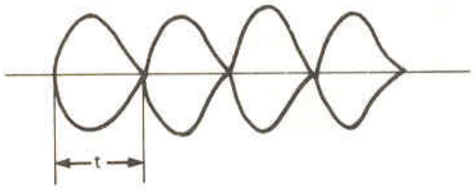


Fig. 5

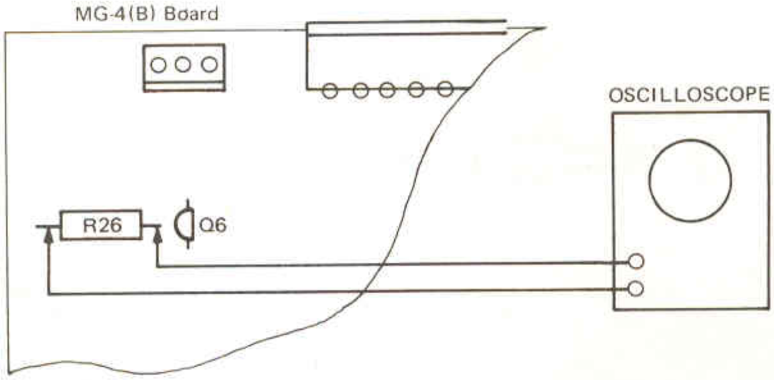


Fig. 6

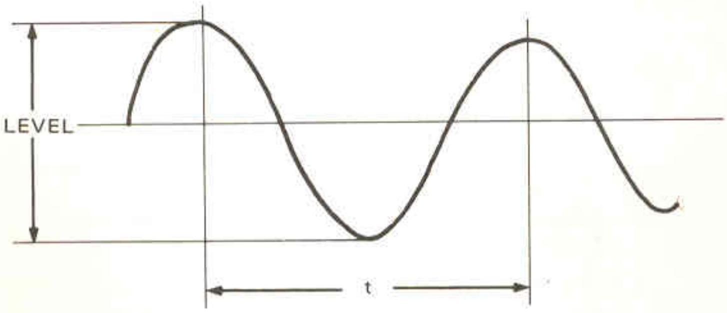


Fig. 7

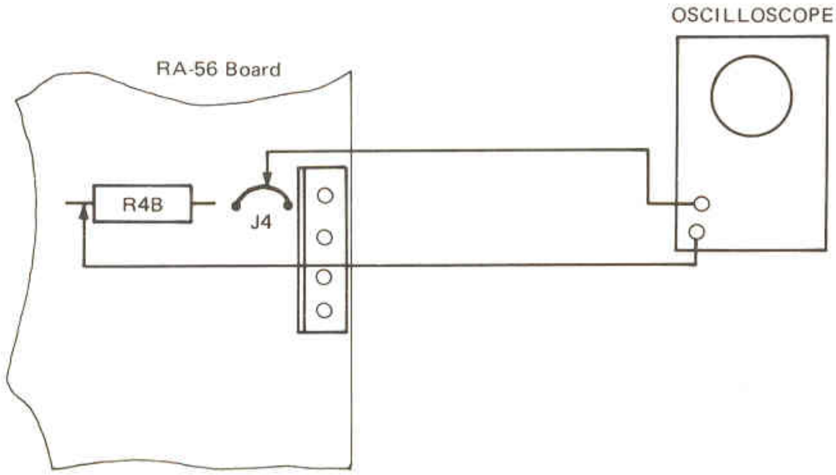


Fig. 8

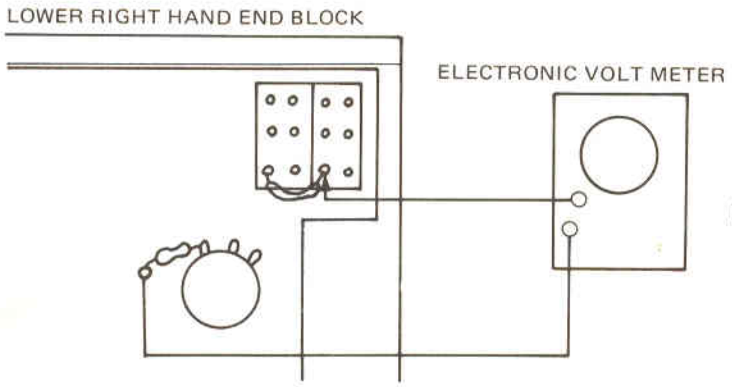


Fig. 9

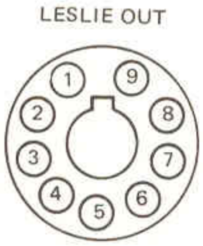


Fig. 10

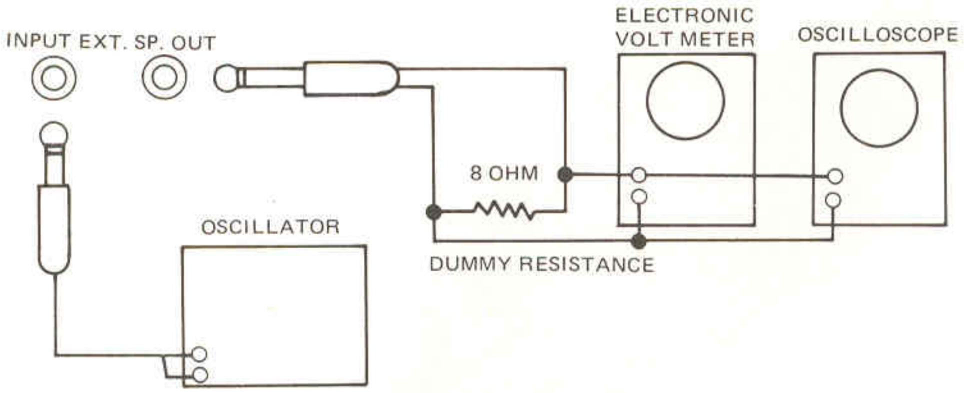
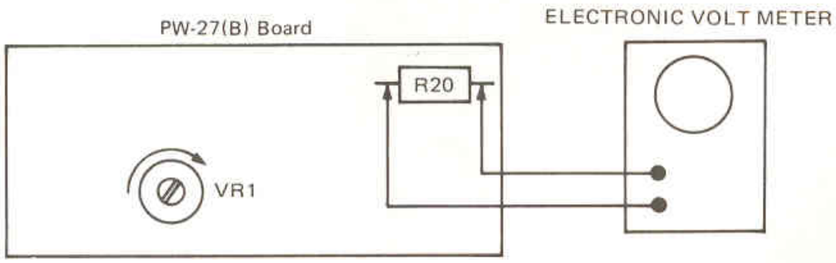


Fig. 11

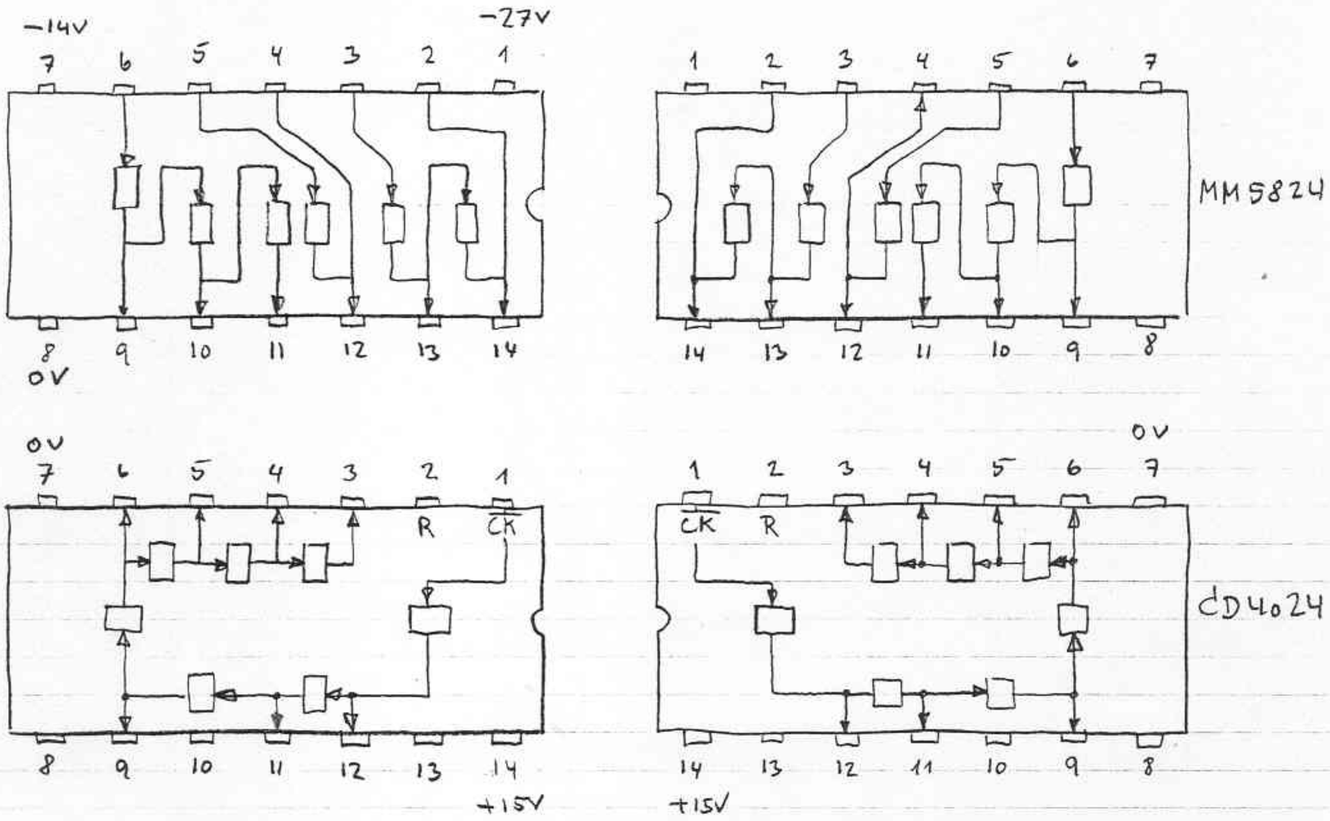


X-5 (18150K)
(WITH PEDAL COUPLER)

MDD BUFFER BOARD (EF-12A)		223-35342
TRANSISTOR		
Q1 thru Q12	2SC945Q	305-03040
DIODE		
D1 THRU D11	1S2473	306-01017
D12 (12 Volt Zener)	022-12A	337-02005
MDD GENERATOR BOARD (MG-4B)		228-19212
IC-1		319-03001 or 319-03002
IC-2		319-01005
IC-3		319-01006
TRANSISTOR		
Q1 THRU Q3	2SC1675	305-03063
Q4 THRU Q6	2SC945Q	305-03040
DIODE		
D1	1S2206	306-05001
D2, D3	1S2473	306-01017
D4 (5.6V Zener)	RD-5.6 EB	337-06014
DIVIDER GENERATOR BOARD (DV 4-C)		229-20218
IC-1 THRU 12	MM5824	319-01007
DIODE		
D2 THRU D 74	1S2473 or	306-01017
	1S1555	306-01005
BASS GENERATOR BOARD (EF-24)		223-35386
IC-1 THRU IC-3	MC14532 CP(8 Bit Priority Endcoder)	319-09001
IC-4 THRU IC-6	MC14512 CP(8 CH. Data Selector)	319-10001
IC-7	MC14025 CP(Triple Nor Gate)	319-06007
IC-8 THRU IC-14	MC14011 CP(Quad Nand Gate)	319-06006
IC-15	MC14013 CP(Dual D Flip Flop)	319-03004
TRANSISTOR		
Q1, Q2,Q4	2SC945Q	305-03040
Q3,Q5 THRU Q9	2SA733Q	305-01008
Q10	2SC1000GR	305-03023
DIODE		
D1 THRU D21	1S2473	306-01017
DA-1 THRU DA-6 (DIODE ARRAY)	DAN-4	306-01027
RA-1 THRU RA-6 (RESISTOR ARRAY)	8-33u	320-97004
LOWER MANUAL ASSEMBLY		AK-649A
PEDAL KEY ASSEMBLY		PK-3D

MAIN AMP UNIT		105-07402
Circuit Breaker	1 amp.	302-02004
Transformer		307-01079
Bridge Diode Pak	S-5188)	306-01021
MAIN AMP BOARD	PW 27B	218-02211
IC-1	NPC151A	319-23001
TRANSISTOR		
Q1	2SC945Q	305-03040
Q2	2SD381	305-04012
Q3	2SB536	305-02010
Q4	2SA627	305-01009
Q5	2SD188	305-04011
DIODE		
D1, D2 (15v Zener)	RD15EC	337-06013
D3, D4	1S2473	306-01017
PRE AND REVERB AMP BOARD (PA-56)		219-51206
IC-1	MPC151A	319-23001
TRANSISTOR		
Q1, Q7, Q8	2SA493GR	305-01006
Q2 THRU Q6	2SC1000GR	305-03023
Q9	2SC509Y	305-03041
Q10	2SA509Y	305-01014
DIODE		
D1 THRU D3	1S2473	306-01017
POWER SUPPLY UNIT		105-09302
Power Transformer	120V E-06ul	307-01078
Power Transformer	100V & 230v E-06	307-01077
Fuse Board	100v,120v, PS-23	224-14341
Fuse Board	230v	224-14342
Fuse	100v & 120v 5A	302-01018
Fuse	230v 3A	302-01019
POWER SUPPLY BOARD PS-17		224-14216
TRANSISTOR		
Q1	2SD234	305-04005
Q2, Q3	2SA490Y	305-01013
DIODE		
D1	1B2C1	306-01023
D2	1B2Z1	306-01024
D3, D4 (15v Zener)	RD15EC	337-06013
D5 (27v Zener)	RD27EB	337-06015

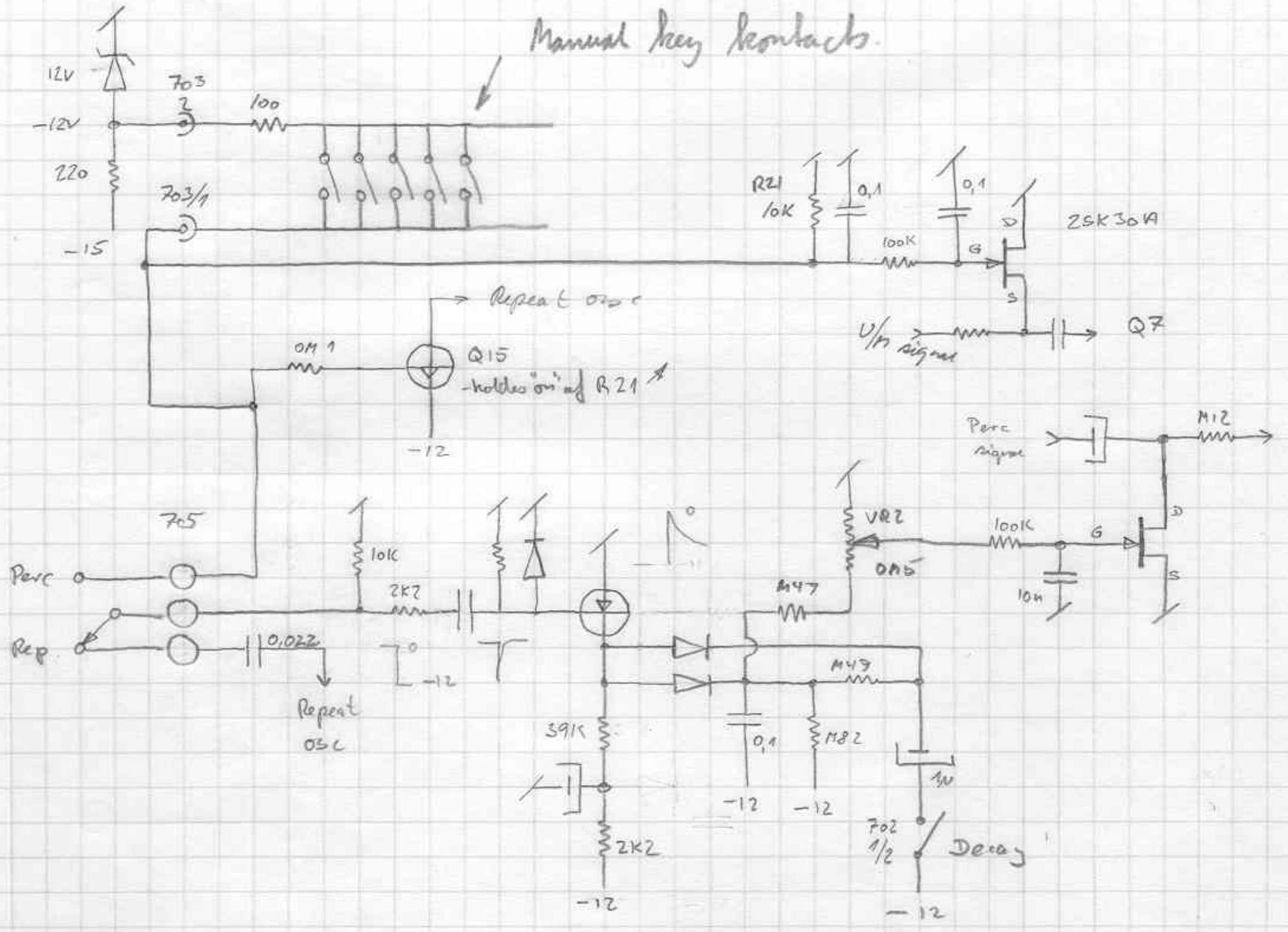
Top Wiev Bottom Wiev

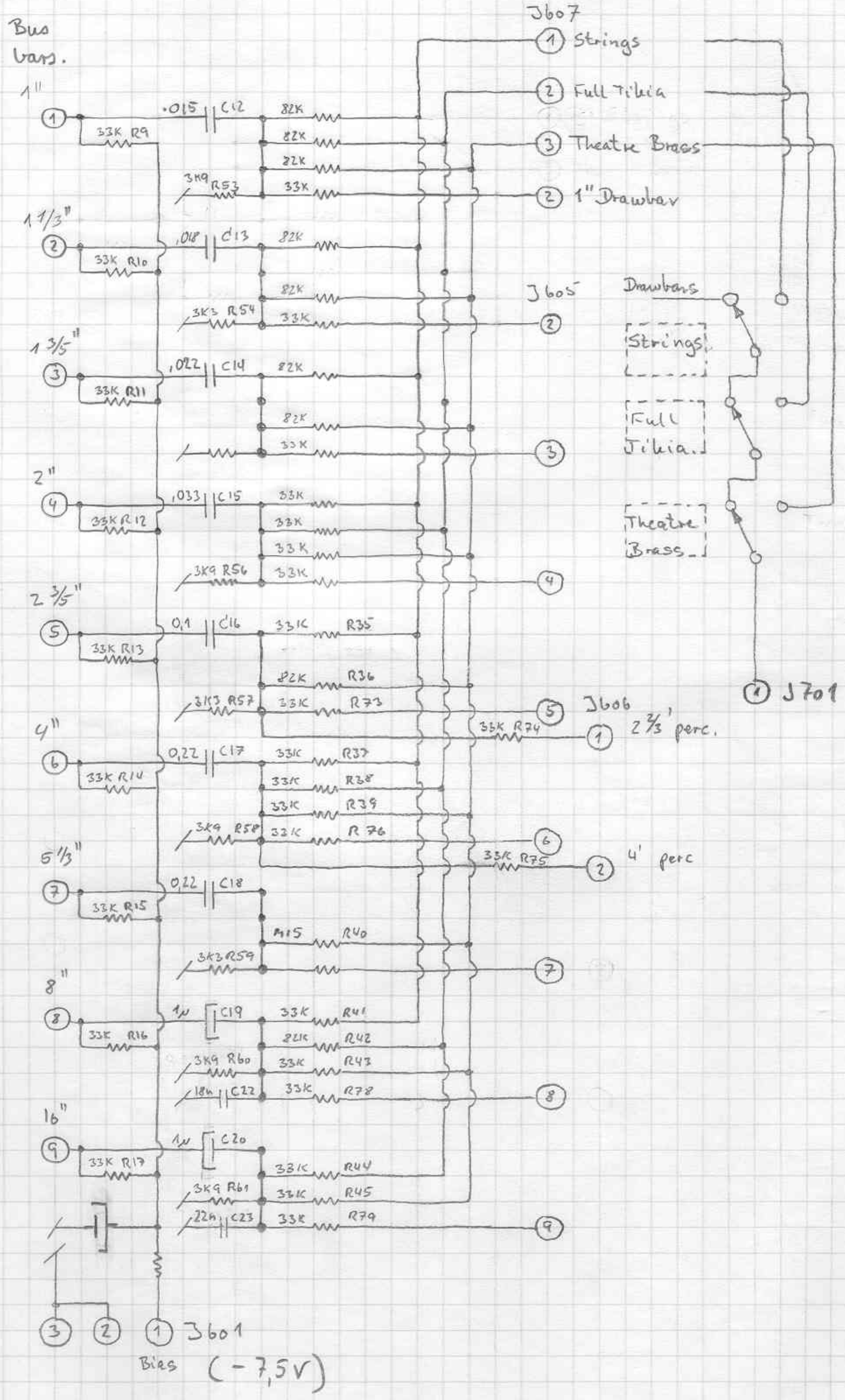


MM5824 kan erstattes m. CD 4024, dog ikke pinkompatibel.

CD 4024 pin:		til MM 5824 pin:	
1	$\overline{\text{Clock in}}$	6	
2	Reset	7	
3	Clock ÷ 128		
4	Clock ÷ 64	14 (& 2)	
5	Clock ÷ 32	13	
6	Clock ÷ 16	12 (& 4)	
7	0V	7	= -14V
8	N.C		
9	Clock ÷ 8	11	
10	N.C.		
11	Clock ÷ 4	10	
12	Clock ÷ 2	9	
13	N.C.		
14	+ 14V	8	= 0V

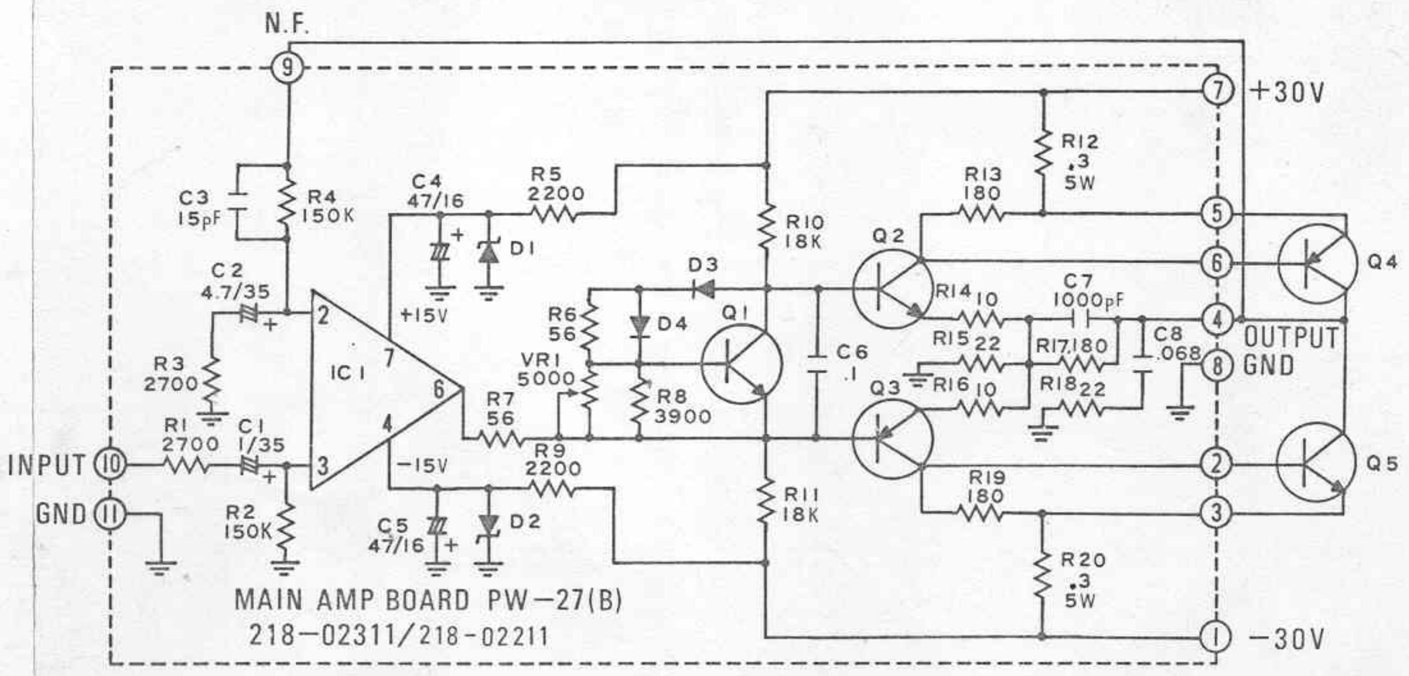
X5 Percussion




Bus bars.
1"
1 1/3"
1 3/5"
2"
2 3/5"
4"
5 1/3"
8"
16"
33K R9
33K R10
33K R11
33K R12
33K R13
33K R14
33K R15
33K R16
33K R17
.015 C12
.018 C13
,022 C14
,033 C15
0,1 C16
0,22 C17
0,22 C18
1µ C19
1µ C20
18n C22
22n C23
3K9 R53
3K3 R54
3K9 R56
3K3 R57
3K9 R58
3K3 R59
3K9 R60
3K9 R61
R35
R36
R73
33K R74
R37
R38
R39
R76
33K R75
R40
R41
R42
R43
R78
R44
R45
R79
J607
Strings
Full Tibia
Theatre Brass
1" Drawbar
J605
J606
2 2/3' perc.
4' perc
Drawbars
Strings
Full Tibia.
Theatre Brass
J701
J601
Bias (-7,5V)

Check R1 must be 2KΩ
-"- R4 -"- 150KΩ

Av = 56,599.



• NOTES

1 IC 1 319-23001 μPC151A ~ 741S
D1,2 337-06013 RD-15EC
D3,4 306-01017 1S2473
Q1 305-03040 2SC945Q
Q2 305-04012 2SD381
Q3 305-02010 2SB536
Q4 305-01009 2SA627
Q5 305-04011 2SD188

2 RESISTORS(R5,R9,R13,R15,R17,R19) ARE ±10%,1/2WATT.

3 UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS,±5%,1/4WATT.
ALL CAPACITORS ARE IN MICROFARADS.

4 (1) SYMBOL DENOTES NUMBERS IN TERMINALS

Huid Huite
Grey
Sort Black DIN ♀ Solderside

2 of
A.C.
ed by
verall
gain,
ue to
high

Two diodes, D3, and D4, and transistor Q1 represent part of the load seen by I.C. 1 and perform the important function of biasing the output transistors. In order for Q2 and Q3 to be biased on, the voltage drops across collecter to emitter of Q1 must equal the voltage drops across the emitters Q2 and Q3 plus the drops across R14 and R16. The current through the Q1 is determined by R10 and R11, and this current, in turn, determines the voltage drop across the Q1 by VR1. A Q4, Q5 quiescent current of approximately 100Ma is necessary to prevent crossover distortion, then this current determines the voltage drop across R12, or R20, and the voltage is approximately 35 Mv.

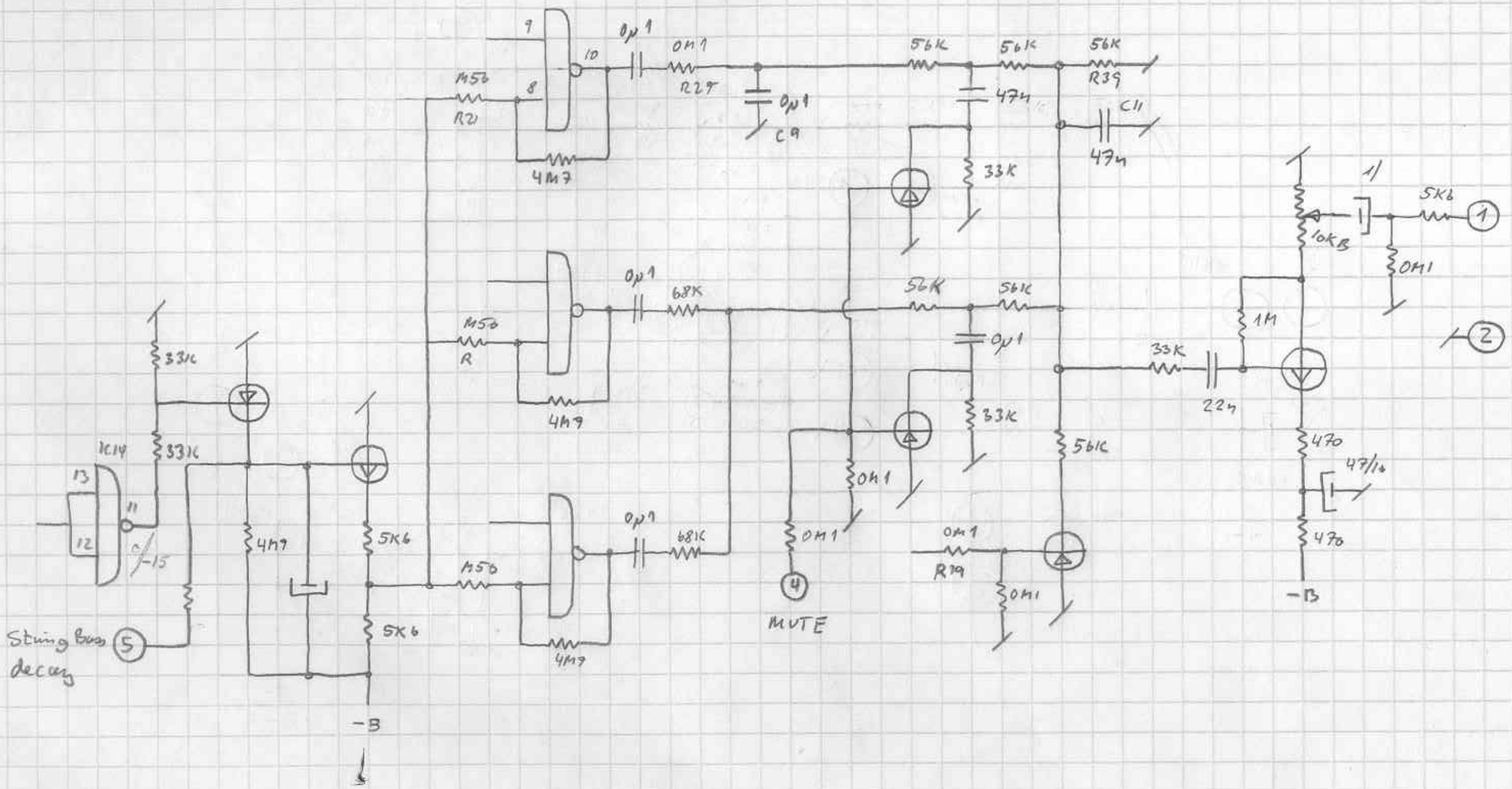
The quiescent current must be determined by adjusting VR1 to clockwise completely, and then counterclockwise to achieve 100Ma.

Transistors, Q2 and Q4, Q3 and Q5, are Inverted Darlington connected. Q2 and Q4 is like a NPN transistor, Q3 and Q5 is like a PNP transistor.

RC pad R18, and C8 across the load provides high frequency stabilization. C7 is high frequency compensation of second stage amplifier, and C3 is high frequency compensation of overall amplifier.

FIGURE 3-10
30W POWER AMP MODULE
(218-02311)
LAYOUT & THEORY

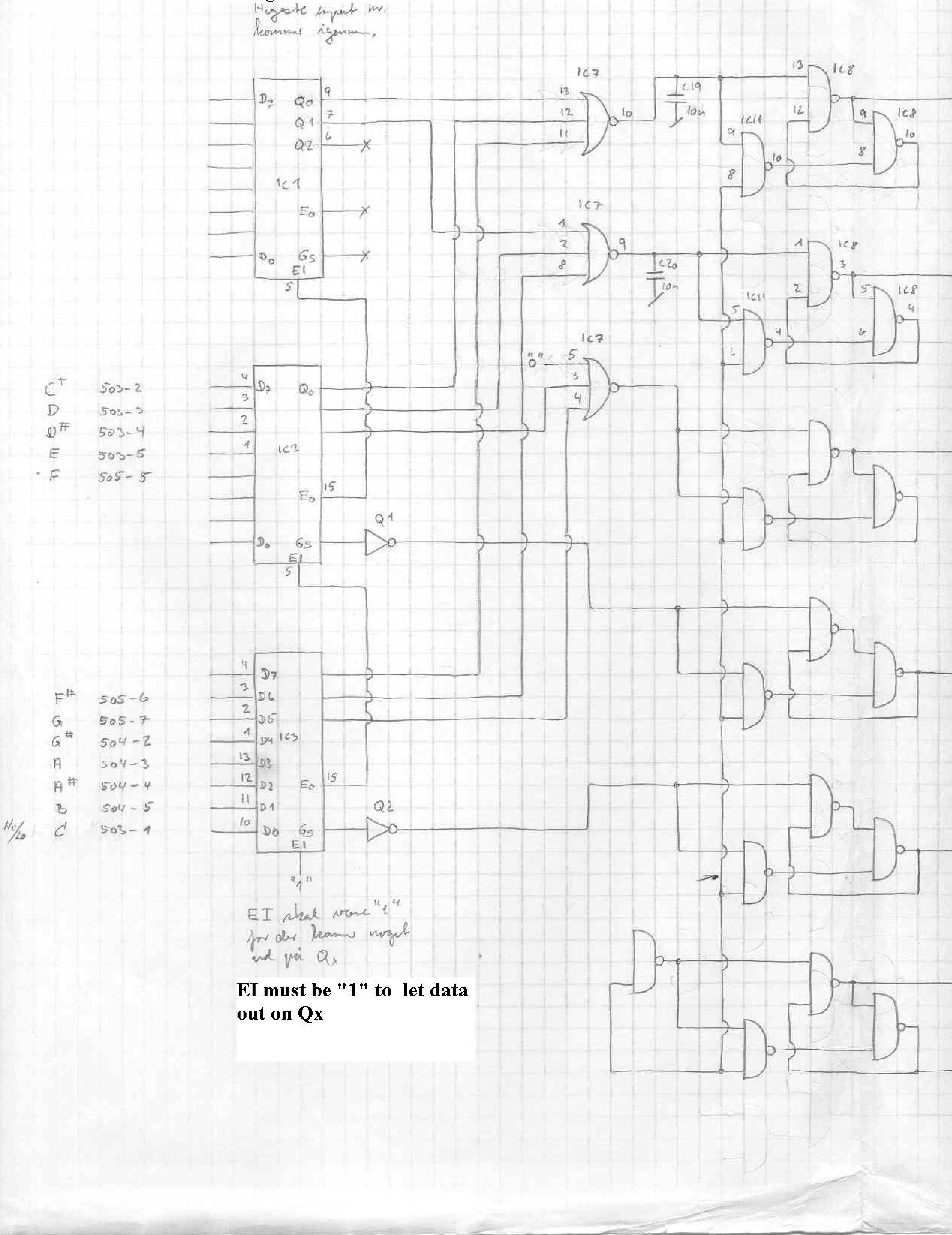
8' voice covers 2 octaves
16' voice can be added.



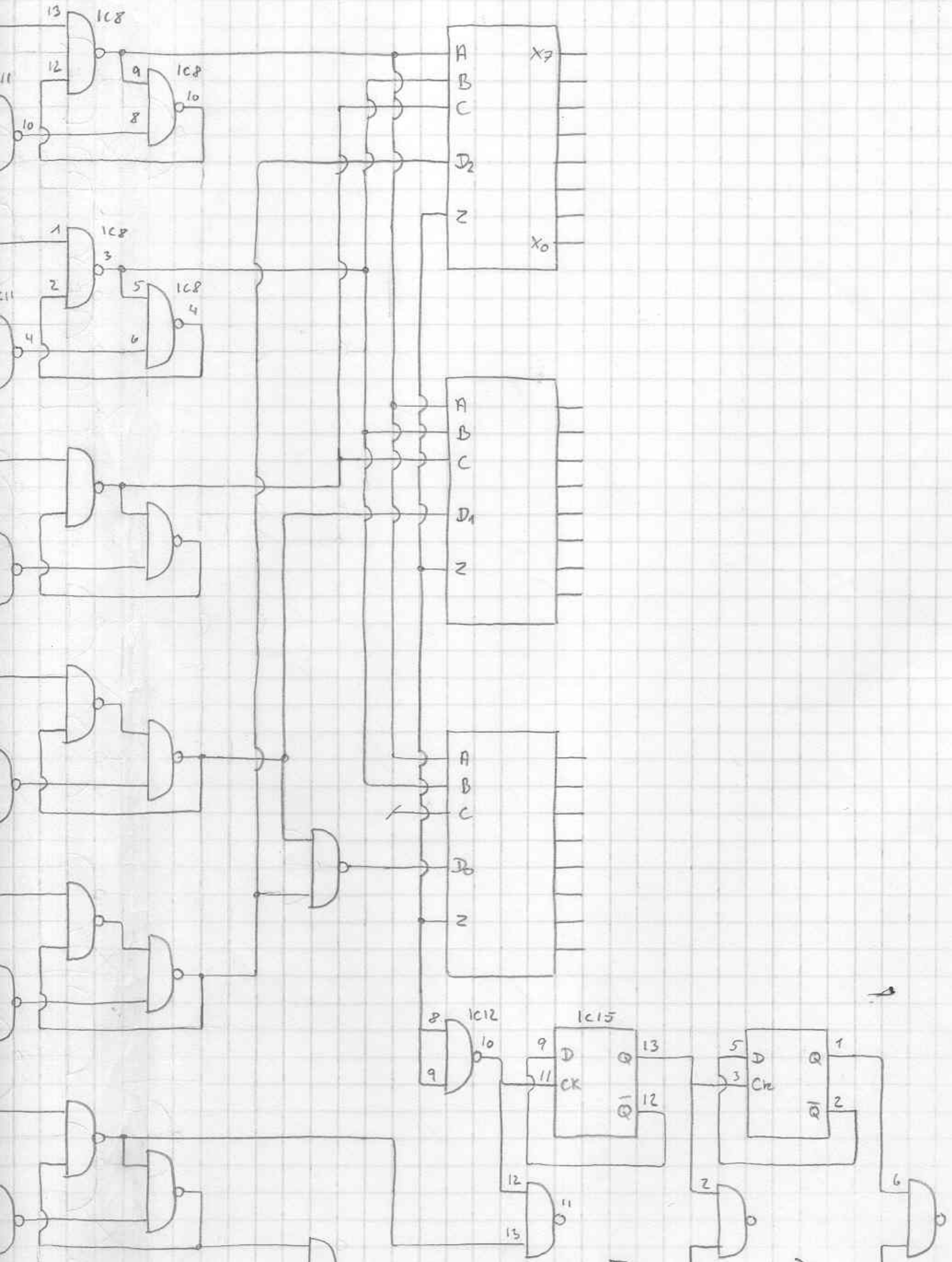
Hammond New X-5

Bass tone output

Highest input number is let through.



EI must be "1" to let data out on Qx



IC8
IC8
IC8
IC8
IC12
IC15
A
B
C
D2
Z
X7
X0
D1
D0
D
CK
Q
Q̄
Ck

